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Dry Land Crops at the Dalhart (Texas) Field Station

By O. R. MATHEWS, Senior Agronomist, and B. F. BARNES,
Associate Agronomist, Division of Dry Land Agriculture
Bureau of Plant Industry

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INTRODUCTION

The United States Dry Land Field Station, Dalhart, Tex. (hereinafter referred to as the Dalhart Field Station), is one of a group of 18 stations in the Great Plains where coordinated experiments in crop rotation and tillage methods are being conducted by the Division of Dry Land Agriculture. Soil-moisture determinations to measure differences in moisture content brought about by differences in cultivation and to study the use of water by crops are an integral part of this work.

Other divisions of the Bureau of Plant Industry cooperate in varietal, date-of-planting, and rate-of-spacing tests with grain sorghums, forage sorghums, and broomcorn, in varietal tests with sundry other crops, in grass seeding tests, and in weather readings. Tests of trees for windbreaks, ornamentals, and small fruits, principally grapes, are also conducted. The principal work consists of field experiments to determine the best-adapted crops and varieties and the methods of production under which they should be grown. The major part of this circular is devoted to field crops.

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[1] The authors wish to acknowledge the assistance rendered by the Soil Conservation Service in compiling the material for this publication.

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GENERAL DESCRIPTION OF THE AREA

The Dalhart Field Station is situated on the Canadian-Cimarron High Plains (western division), about midway north and south but near the eastern edge, at an elevation of approximately 4,000 feet. Elevation decreases and precipitation increases to the eastward, and elevation increases and precipitation decreases to the westward. In general, the section is nearly level or gently undulating except for belts of rough land or sand hills, which border the principal streams and are in many cases several miles wide. Shallow depressions known as wet-weather lakes, which contain water in wet years and lose it in dry years, are fairly common.

Precipitation ranges from more than 20 inches farther east in the Texas Panhandle to less than 14 inches in some localities to the west.

Soils within the section vary widely, and the general tendency is for crops to vary with soil type, the heavier soils being planted to wheat and the lighter soils to sorghums. There is no fast dividing line, however, as sorghums will grow on the heavier soils and wheat is grown on sandy land. During the great expansion of wheat acreage in the late twenties and early thirties, wheat production was extended to soils and areas previously regarded as too risky for wheat production. A succession of dry years, however, focused attention on the risks involved in planting wheat in soils subject to wind erosion, particularly where moisture conditions may be unfavorable, and the conclusion has been reached that certain localities are definitely too risky for wheat.

The area and the soil represented by the Dalhart Field Station are particularly adapted to the production of grain sorghums, and the yields of these crops compare favorably with those in other portions of the southwestern grain-sorghum area. Average yields at Dalhart are as high as or higher than those at Woodward, Okla., and Chillicothe, Tex., where precipitation is higher. Until the extreme drought of the last few years, the section was characterized by its few failures and its good yields in favorable years. The unprecedentedly low rainfall for the period 1933–38 has had the effect of greatly increasing the percentage of failures and reducing the average yields. The average yields here reported should not be above those that might be expected over the period of years for which precipitation records within the section are available.

Since the grain sorghums are so important in the economy of the section and since the work of the station has been focused largely on the sorghums, this circular deals principally with them.

THE DALHART FIELD STATION AND ITS WORK

The Dalhart Field Station, consisting of 160 acres, is in Hartley County, Tex., about 3 miles southwest of Dalhart. It was established in 1907, and the first crop was grown in 1908. When the station was started little was known regarding crop adaptation in the section, and poorly adapted as well as adapted crops were included in the cropping systems. As experience demonstrated the lack of adaptation of certain crops, these were dropped and the work was revised to make wider use of the crops that showed promise. Yields of the discontinued crops and rotations are shown in detail in another publication (*3*)[2] and will not be repeated here.

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[2] Italic numbers in parentheses refer to Literature Cited, p. 51.

The soil on the Dalhart station, according to a detailed survey made by the Soil Conservation Service, consists of seven types that are further differentiated by the degree of wind erosion to which they have been subjected.

The survey shows that all of the land occupied by the rotation and cultural-method experiments lies on a slope of less than 2 percent. Only two soil types are of any importance in the experimental field. One, which constitutes at least 80 percent of the cropped acreage, is classed as deep, moderately sandy, diversified cropland. It has suffered no soil removal by wind erosion, but has a shallow accumulation of soil from adjoining land. The other, practically all of which is located in the north field, is an eroded phase of the former and is classed as medium-depth, moderately sandy, grazing and feed cropland. From 25 to more than 75 percent of the A horizon has been lost by wind erosion, but there has also been some accumulation. Contemporary notes show the loss of soil by wind erosion at locations that check closely with those represented by the second type on the soil map. The degree of wind erosion has an important bearing on the yield of crops. The crop-producing capacity of the eroded land appears to have been impaired.

CLIMATIC CONDITIONS

The annual precipitation is variable, the extremes during the period of observation ranging from a maximum of 33.40 inches in 1923 to a minimum of 9.78 inches in 1934. The average precipitation for the 31-year period 1908–38, reported in table 1, is 17.50 inches.

TABLE 1.—*Precipitation at the Dalhart Field Station for 31 years, 1908–38*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Seasonal, Apr.-Sept.	Annual
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1908	T[1]	0.85	0.04	2.28	0.53	2.83	4.11	1.08	0.39	0.29	0.99	0.00	11.22	13.39
1909	T	.28	.71	.18	1.70	5.10	1.27	.65	2.12	2.60	1.21	.15	11.02	15.97
1910	0.20	.03	.12	1.51	2.96	4.04	2.48	3.28	.05	.00	.07	.02	14.32	14.76
1911	.00	.54	.43	.59	3.37	.28	3.65	1.87	.58	1.72	.25	1.28	10.34	14.56
1912	.00	1.30	.38	2.56	2.37	3.36	1.68	2.64	1.98	.05	.00	.03	14.59	16.35
1913	.06	.14	.02	.88	2.35	1.29	.85	1.50	1.45	.19	1.78	3.18	8.32	13.69
1914	.05	T	T	3.98	7.29	3.65	2.58	1.38	.32	3.00	.00	.56	19.20	22.81
1915	.19	.72	.42	5.15	2.58	2.15	3.70	2.11	1.21	2.60	.10	.01	16.90	20.94
1916	.44	.00	.12	1.49	.69	4.42	2.55	3.45	.72	.22	.03	.37	13 32	14.50
1917	.14	.09	.03	.37	2.70	.93	1.64	2.28	1.28	.31	1.02	.00	9.20	10.79
1918	.27	.05	2.85	.89	4.87	1.23	1.49	1.67	1.49	1.87	.25	1.74	11.64	18.67
1919	.09	.96	3.18	3.48	2.75	1.88	2.41	3.45	5.12	2.50	1.14	T	19.09	26.96
1920	.36	.43	.05	.32	3.25	6.81	2.56	1.33	.81	4.49	.34	.08	15.08	20.83
1921	1.80	.08	.15	.76	3.70	5.82	5.12	.69	.04	.54	.00	.26	16.13	18.96
1922	.37	.67	.73	5.20	5.06	3.40	1.57	1.88	.52	.15	.36	.02	17.63	19.93
1923	.00	1.03	1.72	4.09	1.78	6.05	.87	6.92	2.10	6.29	1.23	1.32	21.81	33.40
1924	.05	.09	1.61	1.16	2.44	.69	1.32	5.00	1.72	1.01	.24	.03	12.33	15.36
1925	.07	.34	.54	1.12	3.36	1.93	4.09	3.00	4.56	1.16	.35	.14	18.06	20.66
1926	.19	.01	1.00	2.84	3.70	4.00	.68	1.32	2.05	.33	.10	.81	14.59	17.03
1927	T	.33	.29	.90	.00	3.59	4.85	4.53	2.76	.22	T	.05	16.63	17.52
1928	.00	.27	.80	.47	6.28	3.37	3.14	4.91	.13	4.25	1.75	.79	18.30	26.16
1929	.04	.56	2.43	.40	2.21	2.91	1.60	5.66	1.53	1.04	.89	.09	14.31	19.36
1930	.09	T	.63	2.53	1.50	5.58	4.09	2.28	.66	6.79	.36	T	16.64	24.51
1931	.27	.40	1.64	2.13	1.92	.85	2.37	2.40	.80	.85	.36	.31	10.47	14.30
1932	.42	.46	.30	1.61	1.44	8.74	1.24	1.68	1.71	.81	.18	.86	16.42	19.45
1933	.02	.17	.04	.08	.80	.66	.56	5.61	.54	.76	.90	.00	8.25	10.14
1934	T	.34	.09	.81	1.52	1.48	.66	1.14	1.94	1.46	.34	T	7.55	9.78
1935	.68	.02	.27	T	2.05	1.63	2.91	2.26	1.89	.65	.87	.08	10.74	13.31
1936	.37	.01	T	.01	3.67	2.44	1.49	.25	1.19	.07	.02	.41	9.05	9.93
1937	.01	.10	.60	1.04	5.86	1.23	1.68	1.27	1.27	.95	.15	.32	12.35	14.48
1938	T	.40	.78	.64	1.43	1.11	1.49	1.04	4.12	2.52	.04	.51	9.83	14.08
Average	.20	.34	.71	1.60	2.78	3.01	2.28	2.53	1.52	1.60	.49	.43	13.72	17.50

[1] T=trace.

The major portion of the precipitation falls during the summer, the average for the 6-month period April to September being 13.72 inches, or 78 percent of the total. May, June, July, and August are the months of heaviest precipitation. Within this 4-month period is a relatively dry one not revealed by the monthly averages. Figure 1 shows the precipitation for the year by 10-day periods. It will be noted that there is a period of high precipitation early in June and another early in August. These two periods explain to a considerable extent the excellent adaptation of sorghums. The heavy precipitation in early June provides moisture for their germination and early growth. That in early August provides moisture urgently needed for heading.

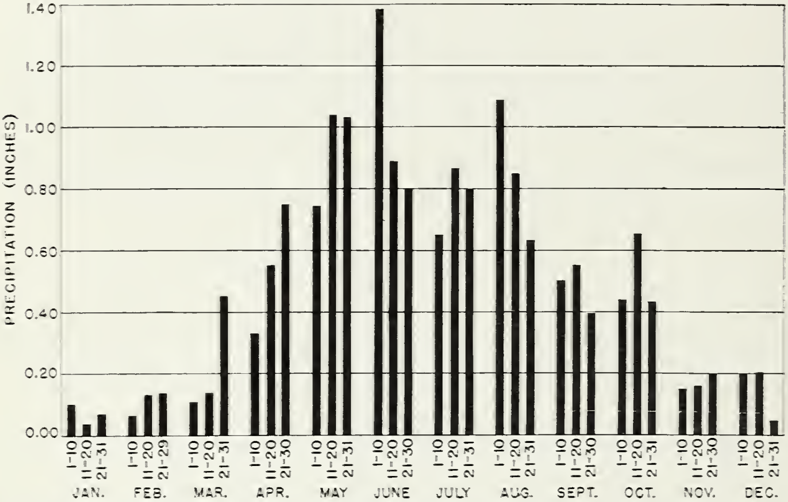

FIGURE 1.—Precipitation by 10-day periods at the Dalhart Field Station. (Average of 30 years' records.)

The precipitation has an important bearing on the best dates of planting for sorghums. Those planted early are likely to head under adverse conditions in July. Those planted so that they head during the early part of August have more favorable conditions on the average during this critical period and are then able to complete their growth under the more moderate temperatures that prevail after the middle of August.

Hailstorms have not been uncommon, but the most severe storms have occurred in May or early June, before the sorghums had reached a stage of growth sufficiently advanced to be badly damaged. Excellent yields of sorghums have been harvested in years when hail has destroyed or badly damaged small-grain crops.

Table 2 shows the total monthly and seasonal evaporation, the monthly mean, mean maximum, and mean minimum temperatures, and the wind velocity.

Table 2.—*Average monthly and seasonal evaporation, average monthly and annual wind velocity, and average monthly and annual mean, mean maximum, and mean minimum temperatures at the Dalhart Field Station, 1908–38* [1]

Item	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total or average
Evaporation inches	-----	-----	-----	7.125	8.664	9.629	10.160	9.219	7.135	-----	-----	-----	51.931
Mean temperature °F	32	36	43	53	63	73	77	75	68	55	42	33	54
Mean maximum temperature °F	48	52	59	69	77	87	92	90	83	71	58	48	69.5
Mean minimum temperature °F	17	20	28	38	49	58	63	61	53	40	27	18	39
Wind velocity miles per hour	6.4	7.3	8.4	8.9	8.1	6.7	5.9	5.2	5.9	6.0	6.2	6.0	6.7

[1] Wind velocities and temperatures are for 1909–38.

The evaporation is measured from a tank 6 feet in diameter and 2 feet deep set 21 inches in the ground, with the water maintained at approximately ground level. The average evaporation for the 6-month period April to September is 51.931 inches. The extremes range from 42.617 inches in 1926 to 62.402 inches in 1934. The average evaporation is lower than at Garden City, Kans., to the north, Tucumcari, N. Mex., to the west, or Big Spring, Tex., to the south. It is about equal to that at Woodward, Okla., where the relative humidity is somewhat higher. The evaporation during the 6 summer months is about four times the precipitation for the same period. The actual loss of water from the soil is much below the evaporation from a free water surface, but the relatively high evaporation-precipitation ratio shows that water loss by transpiration is likely to be an important factor and indicates that unwanted plant growth such as weeds should be eliminated as far as possible and the water conserved for crop plants.

The average mean temperature for the year is 54° F. June, July, and August have average mean temperatures of 73°, 77°, and 75°, respectively. Daily maximum temperatures are not extreme in comparison with those in other parts of the Great Plains area. The extreme maximum temperature, 106°, has been materially exceeded at all dry-land stations in Kansas, Nebraska, and the Dakotas.

The average frost-free period is 176 days. The average date of the last killing frost in the spring is April 25, and that of the first in the fall is October 18. The growing season is long enough to permit the normal ripening of the commonly grown sorghums. In an occasional year a crop whose heading has been delayed by drought may suffer frost injury. The date of the last frost in the spring has little effect on the growth of sorghums, as their optimum time of planting is much later than the date of the last spring frost. The effective frost-free period is determined by the date of the first fall frost, rather than by the period between the last frost in the spring and the first in the fall.

The mean wind velocity, measured with a four-cup anemometer 2 feet above the ground surface, for the 30-year period 1909-38 is 6.7 miles per hour. The wind movement is highest during March, April, and May, and the most severe soil blowing is likely to occur during

March and April, although in extreme seasons danger from soil blowing persists over a much longer period.

The wind velocity reported in the table is below what might normally be expected. The instrument yard was located before tree plantings were made on the station. After plantings began to make growth they affected the wind-velocity readings by imperceptible degrees. In later years a realization of this fact led to the location of an anemometer in an exposed location in the pasture. During the 5-year period 1934–38 the average velocity recorded by the pasture anemometer was 9.0 miles per hour, while that recorded at the anemometer nearer the buildings was only 6.5 miles per hour.

Detailed monthly records will be found in tables 20 to 22 of the appendix.

WIND EROSION

The erosion of soil by wind has been a serious problem at the Dalhart Field Station ever since the start of the work. The land was broken from the sod in 1907, and the first crops were grown in 1908. Soil blowing was first noted in 1910, when contemporary notes stated: "It was impossible to keep the soil from blowing * * * and all plots of winter wheat were practically ruined. The winter rye * * * withstood the blowing better than the wheat." Other damage to grain crops from soil blowing was noted in 1912, 1914, 1917, and 1918.

Much of the prevalence of soil blowing during the early years can be fairly laid to the cultivation methods used. At that time the dust mulch was considered necessary to dry-land crop production, and the preparation of a smooth surface by use of the disk and harrow was an accepted practice. This naturally created a surface without obstructions and left it in a condition susceptible to blowing. After beating rains, blowing sometimes took place while the soil was still too wet to cultivate.

After the first experiences, it became apparent that something must be done to control soil movement, and active efforts to combat it were introduced. In 1914 the notes state—

> while some of the small-grain plots were destroyed by soil blowing * * *, the aggregate amount of damage done was comparatively small. The soil being in good physical condition, all cultivations were effective, and blowing was easily checked.

It was recognized then that soil blowing could be checked before it had gained headway, but the assumption that a finely pulverized surface was necessary to the conservation of water and to successful crop production persisted. Efforts were still directed toward checking soil blowing after it started, rather than toward keeping it from starting.

In the course of the next few years, however, it became evident at this and other stations that a fine mulch was not essential to crop production and that maintenance of a roughened, cloddy surface was not incompatible with moisture conservation. Recognition of this fact materially altered cultural practices.

Cultivation in advance of actual blowing is noted in the records for 1919. They state:

> As soon as a piece of ground began to get smooth we started the cultivators and ridged it up again. By cultivating the field several times with the outside shovel on each cultivator [two shovels on each cultivator], damage to all crops was prevented.

The principles of rough cultivation and the use of rye as a winter cover crop on bare land, together with generally favorable rainfall conditions, minimized soil blowing until 1933. References to it were made in a few years, but in no case was the damage serious.

Since 1933 a different situation has prevailed. Breaking out sod land on surrounding fields introduced a new factor—the necessity of checking the inroads of soil from neighboring fields. The severe drought and poor crops in 1933 and succeeding years left much land in condition to blow. Low rainfall prevented adequate growth of cover crops. Little or no soil movement originated on the station fields, and most of the soil from neighboring fields was held from the croplands for several years by mechanical obstructions. In the winter of 1937–38, however, the quantity of moving soil became too great to hold by mechanical means, and heavy drifting of soil across station fields took place. There was apparently little actual cutting on the station fields, and the net result was probably a slight accumulation rather than a loss of soil.

The potential crop-producing capacity of the station as a whole has probably been reduced very little by wind erosion. There are a few spots, however, in the north field that are distinctly lower in production than surrounding plots, and field notes ascribe this lowered production to severe soil blowing in earlier years.

Information on practices to control soil blowing can be found in publications devoted to the subject (*4, 5, 6, 7, 11*) and will not be discussed here.

That soil blowing will continue to be a serious problem is apparent. It is also evident that complete control of soil blowing is not likely ever to become an accomplished fact. The most that can be expected is to limit it so that the damage done will be negligible.

Soils that have once blown apparently reach a condition more susceptible to blowing, owing to lack of undecomposed roots and at least in part to the blowing away of the lighter soil particles with the resultant increase in sand content and changed structure of the remaining topsoil.

PYTHIUM ROOT ROT OF MILO

Root rot of milo (caused by *Pythium arrhenomanes* Drechs.) was present in a quantity sufficient to be recognized in 1930. At that time apparent injury due to disease was noted on some of the milo plots in the listing methods and on plot F of the continuous-cropping series in the south field. It affected only portions of plots. In 1931 the disease was again noted on the same plots in increasing severity. It was also observed on other plots, but the character of the season was such that it was difficult, with the knowledge of the disease then at hand, to distinguish between slight injury by disease and injury from other causes. It was definitely observed in the north field for the first time on four plots, the diseased area varying from a few square rods to most of the plot. The plots affected were plot F of the continuous-cropping series, plots H′ and A′, and plot B of rotation 293.

In 1932 the disease was observed on all the plots noted in previous years and on seven additional plots. It may have been present on many more, but drought injury to milo made it difficult to distinguish between injury due to disease and that due to drought.

In 1933 severe drought conditions delayed planting until August. The milo did not make enough growth to show injury, and the disease had no bearing on results.

A change to disease-resistant milo was made in 1934, but the yields for that year were still influenced by the disease. The spots where disease had dwarfed or killed the milo in previous years were noticeably better than normal places in the field, probably because of moisture not removed by the injured plants. Since 1934 there has been no injury from root rot on the rotation plots.

In the variety tests, the disease was not present in noticeable quantities prior to the drought of 1932, and in that year injury from drought and injury from disease could hardly be separated. After 1932 an attempt was made to avoid disease injury by moving the variety test to different land each year. Severe drought in succeeding years, however, made it practically impossible to determine to what extent this practice was successful. It is now evident that the disease is rather widely disseminated and that yield tests of varieties of sorghum not resistant to root rot are meaningless. Milo planted in 1938 on land where it had not been grown for at least 10 years was practically destroyed.

The disease affects milo, darso, and most of the hybrids of milo with resistant species or strains. It has also been observed on Extra Early Sumac sorgo.

The continued growth of milo appears to be dependent on the use of disease-resistant material. Several resistant strains of Dwarf Yellow milo are under trial, and one strain, Finney, has been rather widely distributed. Rapid progress is being made in the development of strains of other types of milo that will be disease resistant.

The extent to which root rot occurs over the section as a whole has not been determined. The damage caused by it is so frequently attributed to drought injury, insect damage, or poor soil condition that only an extensive, critical study of the section during late summer would afford a correct estimate of its distribution.

CROP PRODUCTION

The crop-rotation and cultural-method trials are conducted on 177 tenth-acre plots located in 3 fields. Variety tests, rate-of-seeding trials, and tests with crops not included in the rotations are conducted on other land.

In these rotation experiments the same variety of each crop was grown on all plots in any given year. Varieties were changed as experience indicated the better adaptation of other varieties, or as some special condition made it necessary.

For example, Standard Yellow milo was used until Dwarf Yellow milo had been definitely proved to be more desirable. The change was made in 1926. Dwarf Yellow milo was grown during the next period of years, but early in the thirties milo disease (pythium root rot) made its appearance on several plots and made a further change necessary. Finney, a disease-resistant strain of Dwarf Yellow milo, was substituted as soon as sufficient seed was available. This change was made in 1934. It is one of the few cases on record where development of a resistant variety of a crop has kept pace with the incidence of the disease.

With all crops an effort was made to use an adapted variety and not to change to another variety until the superiority of the latter had been clearly established. In some few cases, as with soybeans, where little was known regarding variety adaptation at the time work was started, a variety was used that proved to be considerably less productive than some other variety that might have been substituted. The varieties used in the different years are listed in table 23.

CROP ADAPTATION

The average annual yields of the crops in the rotation plots are shown in table 3. These yields are a composite of those from all fields and embrace all the crop sequences and methods of tillage used in the production of each crop. Where there is a considerable number of plots of a crop, as of milo or kafir, the relative number of plots grown under good and poor methods of cultivation is fairly evenly distributed and the average figure used can be considered representative of the crops. Where a small number of plots of a crop are grown there is generally not so good a balance among methods, but the small number of plots usually indicates that the crop is relatively unimportant.

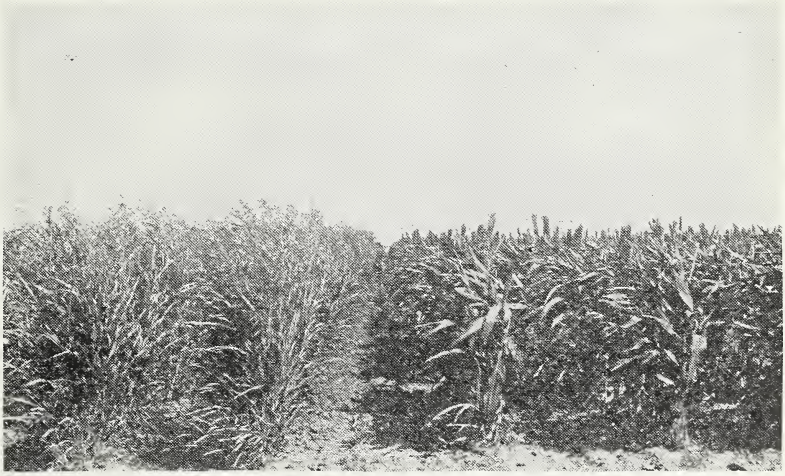

FIGURE 2.—Sudan grass (left) and kafir (right) at the Dalhart Field Station. Like most sorghums, these are well adapted to the soil and climatic conditions at Dalhart.

As the average yields show, milo has been the most productive crop, although many of the sorghums show a high degree of adaptation. Kafir, sorgo, and Sudan grass (fig. 2) are all productive when conditions are at all favorable. The yields of milo average higher than those of kafir but appear to fluctuate more from year to year.

Table 3.—*Average annual acre yield of crops grown in all crop-rotation and methods-of-cultivation plots, 1908–38, and average for all years*

Year	Milo grain	Kafir		Corn (grain)	Oats (grain)	Winter wheat (grain)	Winter rye (grain)	Dry beans	Peanuts (nuts)	Sorghum in rows (total)	Sorghum drilled (total)	Cowpea hay	Sudan-grass hay	Soybean hay
		Grain	Total											
	Bu.	*Bu.*	*Lb.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
1908	27.7	0	4,092	0	0	0	------	------	------	2,880	------	------	------	------
1909	5.4	0	5,030	0	1.5	0	------	------	------	3,900	------	------	------	------
1910	35.8	35.8	13,363	12.7	0	0	------	------	------	5,950	------	------	------	------
1911	12.7	8.5	4,510	.7	0	0	------	------	------	2,190	------	------	------	------
1912	34.9	8.4	6,204	13.0	0	0	------	------	------	6,570	------	------	------	------
1913	1.7	3.5	3,158	0	.5	0	------	------	------	2,950	------	------	------	------
1914	50.2	34.6	8,664	23.3	15.5	11.3	------	------	------	7,690	------	1,927	------	------
1915	36.9	38.7	7,894	45.6	10.3	7.2	8.8	------	------	6,100	------	0	2,469	------
1916	17.1	13.3	4,911	8.7	0	0	8.3	------	------	3,200	------	396	1,490	------
1917	8.7	3.0	2,044	.8	0	0	0	------	------	2,350	------	919	835	------
1918	16.1	11.2	3,309	0	0	0	0	0	400	1,750	------	1,136	504	------
1919	34.3	29.6	5,124	13.3	19.7	21.7	28.3	8.0	700	5,250	------	1,368	3,219	------
1920	26.1	22.2	5,638	19.2	0	------	21.3	1.5	0	5,100	------	1,947	3,720	------
1921	23.3	24.8	5,444	23.9	14.2	------	20.8	5.3	560	4,690	------	1,950	4,063	------
1922	20.8	15.9	4,460	9.0	0	------	0	2.5	460	2,650	------	1,160	3,225	------
1923	22.7	26.7	7,470	19.5	0	------	0	9.0	1,090	2,450	------	1,174	2,650	------
1924	22.6	29.3	5,873	23.7	5.2	------	7.4	0	620	4,275	------	1,741	3,693	------
1925	28.6	34.1	8,715	29.4	0	------	0	5.0	330	11,020	3,967	2,200	4,417	------
1926	26.3	26.9	6,407	18.2	23.5	[1] 45.6	18.6	0	350	8,925	4,417	1,700	4,467	------
1927	24.6	13.7	4,738	13.3	0	.4	0	3.8	(2)	7,000	5,933	1,653	3,750	------
1928	37.9	32.5	5,559	29.3	22.1	7.4	6.5	4.3	600	8,975	6,217	1,897	4,933	------
1929	38.2	29.4	5,898	23.6	35.7	20.2	14.6	5.0	460	8,900	6,800	3,191	5,133	------
1930	35.7	30.2	4,813	21.0	8.7	12.0	10.7	5.1	637	8,100	5,383	2,147	5,067	2,225
1931	30.4	31.4	4,847	17.2	15.4	27.5	13.3	5.0	833	8,300	3,913	2,462	4,783	2,275
1932	17.6	17.5	3,561	6.8	1.3	8.1	8.5	.3	383	5,125	3,113	1,575	2,950	1,200
1933	0	0	0	0	0	.7	.6	0	0	0	0	0	0	0
1934	2.1	3.5	1,597	.1	0	0	0	1.7	17	350	1,675	244	217	0
1935	11.1	16.9	4,907	1.9	0	0	0	1.8	433	4,655	5,813	1,996	2,027	1,325
1936	2.0	3.1	2,604	.2	0	0	0	0	80	2,200	1,700	697	567	950
1937	14.2	17.6	4,047	3.3	0	0	0	1.0	277	5,875	4,413	1,121	2,683	1,275
1938	6.3	7.5	2,637	.2	0	0	0	0	360	4,100	3,788	1,056	2,450	325
Average	21.7	18.4	5,081	12.2	5.6	[3] 6.4	7.0	2.8	430	4,951	4,081	1,426	2,888	1,064

[1] Not included in average.
[2] Destroyed after harvest before yield was determined.
[3] Average 1927–38.

Sudan grass is important for other things than the production of hay. It is the surest summer-pasture crop, and the stubble, when not harvested or pastured too closely, is an efficient protection against wind erosion.

Average yields of small grains are not high at Dalhart, although on heavier soils to the eastward winter wheat is an important crop. The soil at Dalhart is capable of producing high yields of winter wheat, as is evidenced by the high yield in 1926 (which is omitted from the average because all plots were on summer-fallowed land) and the good yields in 1929 and 1931. The failures during the years 1908–13 cannot be attributed entirely to drought, as soil blowing, damage by rabbits, and hail were contributing factors. It is probable that had the control of soil blowing been as well understood at that time as in later years, some small yields might have been harvested. When the work was revised in 1918, winter wheat was dropped entirely and winter rye substituted, and no wheat was grown during at least 2 years when good yields might have been expected. The average yields include only the years since 1926. If the yield for 1926 were included the average would be raised appreciably, but the yield is not comparable with those in other years.

Winter rye has not been as productive as winter wheat, but it is less easily damaged by wind erosion. It shows promise of having importance as a winter cover crop in areas subject to wind erosion. If fall moisture conditions are at all favorable, rye produces a cover that protects the soil during the winter months. Its use is likely to be confined to sections where little wheat is grown, as winter rye is an undesirable mixture in winter wheat. Yields of both winter rye and winter wheat have been reduced in many years by rabbit damage.

Spring-sown small-grain crops have, in general, been unproductive, although good yields may be obtained in rare instances. To mature before hot weather, spring grains should be planted in late February or early March. In many years conditions are not conducive to obtaining a stand at that time. The only spring-sown grain plots now grown are four plots of oats that have been planted each year in order to have a continuous record of a spring-planted small grain.

Corn has been more productive at Dalhart than at most of the other southern dry-land field stations. Its yield of grain, however, is only a little more than half as high as that of milo, and it is much more subject to complete failure. At elevations higher than that at Dalhart, where summers are cooler and the date of the first killing frost in fall is earlier, its importance increases. It is also grown on some very sandy soils where greater difficulty is sometimes experienced in obtaining stands of sorghums. Corn in this area is generally infested by the southwestern corn borer (*Diatraea grandiosella*).

Legumes, such as cowpeas and soybeans, have been grown as much to determine their effect in rotations and because a legume feed appears desirable as for their actual yields. Yields of cowpeas have not been high but have been fairly consistent, with few failures. Annual legumes when harvested leave the soil in a condition susceptible to wind erosion and are preferably grown in alternate 2-row strips with crops the residues of which are more resistant to soil movement.

A few plots of beans and peanuts have been grown to determine their productive capacities over a series of years. Neither crop has proved to be particularly well adapted.

Some crops not included in the rotations have been thoroughly tested in variety trials.

Broomcorn, like most of the sorghums, has shown a high degree of adaptation. During the 10-year period 1923–32 the average yield of brush from the June 15 planting was more than 550 pounds to the acre.

Cotton has produced fair yields in a few years but cannot be called an adapted crop. Experiments indicate that there is a narrow range of time when planting should be done. The soil is usually not warm enough to make planting advisable before May 10. Cotton planted later than May 20 sometimes fails to mature, and when it does mature it does not produce as high average yields as that planted between May 10 and May 20. If conditions during the optimum planting time are unfavorable, prospects of producing a crop are poor. Even under the best conditions the adaptation of cotton is low compared with that of the sorghums.

Sweetclover has been grown in variety and date-of-planting tests since 1925. During the period 1925–32 good stands were obtained in nearly all years from plantings made at monthly intervals from November 15 to April 15. In a few years the April 15 planting was less desirable than earlier plantings. In favorable seasons yields of hay ranging from 1 to 2 tons an acre were harvested, the date of planting apparently making little difference in the yield so long as stands were equally good. Since the winter of 1931–32 conditions have been so adverse that no stands of sweetclover have been obtained. During the period 1925–32 better average stands were obtained from scarified than from unhulled seed.

On land as sandy as that on the Dalhart station, grain sorghums and forage sorghums must be the basis of crop production. Their comparative sureness makes them important also in localities that are suited to wheat. Throughout the general section they are the most dependable crops, and their growth, in conjunction with other crops necessary to their economic utilization, offers the greatest opportunity for the stabilization of farming.

The different crops have been grown continuously under widely different methods as well as in rotations. In the material presented in the following pages, comparable groups of plots are brought together and condensed tables showing particular points are presented. Full records on all crops will be found in the tables in the appendix.

RESULTS WITH CROPS GROWN ON CONTINUOUSLY CROPPED AND ON ALTERNATELY FALLOWED AND CROPPED LANDS

The methods of cultivation used with small-grain crops and with row crops are not comparable, because the growing seasons of the two do not correspond closely. They are therefore discussed separately.

RESULTS WITH ROW CROPS

The average yields of the different row crops with several methods of cultivation on land continuously cropped and on land alternately fallowed and cropped are presented in table 4. Corn, milo, and kafir were grown in two fields, and two sets of yields are presented. The term "fall plowing" is used in the table, but winter plowing might be a more correct designation. Sorghums are removed so late that plowing is usually delayed until late November or December.

TABLE 4.—*Average acre yields of milo, kafir, and corn on land continuously cropped by different methods and on land alternately fallowed and cropped on two fields*

Crop and field	Years averaged	Yield under indicated cultivation method					
		Spring plowed	Fall plowed	Sub-soiled	Listed	Double-disked and listed	Fallowed
Milo:		*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
South	1909–38	21.4	22.0		18.3		35.4
North	1915–38	18.6	19.1	19.8	12.0	12.7	30.0
Kafir:							
South	1909–38	19.0	20.6		17.2		31.7
North	1915–38	18.6	19.0	19.3	14.3	15.1	27.9
Corn:							
South	1909–38	14.1	14.0		14.8		19.1
North	1915–38	12.4	11.4	12.2	9.6	9.5	18.9

The yields of kafir and milo on the different methods of cultivation bear the same relationship to each other in both fields. Fall-plowed land produced a slightly higher average yield than spring-plowed land, but the difference would not be considered significant if the same relationship did not hold on both fields with both crops. The detailed yields given in appendix tables show that in most years the yields on fall-plowed land exceeded those on spring-plowed land. In one year, 1937, the yields on land plowed in the spring exceeded those on that plowed in the fall by such a wide margin that the relative averages of the methods were materially changed. During the period prior to that year a greater difference in favor of fall plowing existed.

Soil-moisture records show that differences in the quantity of water conserved between harvest time and planting time on fall-plowed and on spring-plowed land were, on an average, insignificant. In 1937, however, the spring-plowed plots, which had been plowed immediately preceding a period of high rainfall, had a materially higher water content at planting time, and this was reflected in a higher yield. The tendency over the whole period appeared to be for the fall-plowed plots to produce a slightly higher yield from an equal quantity of water.

The difference in favor of plowing in the fall noted with the grain sorghums did not hold true with corn. The average yields on land plowed in the fall and on that plowed in the spring were practically identical in the south field, and the difference was in favor of the spring plowing in the north field. The difference in the behavior of the corn crop may be largely due to crop adaptation. There appears to be a strong tendency for fall-plowed land to produce higher yields in the more productive years but lower yields in the less productive years. Since for corn, the number of years of low production was considerably in excess of the years of high production, the net result was a less favorable reaction to plowing in the fall.

Subsoiling experiments in which the soil is loosened to a depth of 16 inches were conducted in the north field only. With all three crops the average yield on subsoiled land was higher than that on fall-plowed land, but not enough higher to pay for the additional cost.

Two methods of listing were used in these trials. One of these was used in both fields, and the other in the north field only. The plots of the method designated as listed were given no cultivation prior to planting, when they were planted with a lister-planter. The plots of the method designated as disked and listed were disked once to kill weeds at some time prior to the listing and planting. Results with both milo and kafir show a slight difference in favor of this disking. Corn shows no advantage, but this may be due to the fact that corn is planted earlier, and the control of weeds prior to planting is not important.

With all crops except corn in the south field, listing was less productive than plowing. In all other instances there was a material difference; one that would certainly indicate that the listing methods used could be employed only at a considerable sacrifice in yield.

As listing is the cheapest method of sorghum production and one that best adapts itself to contour planting for moisture and soil conservation, further tests were begun to determine whether the observed depressing effect of listing could be overcome by cultivation of listed land prior to seeding. The degree to which this was accomplished is discussed under Methods of Listing. Alternate fallowing and cropping produced higher yields of all crops than continuous cropping.

Milo appeared to be the most responsive to the favorable condition provided by fallowing.

The practice of fallowing can be recommended only if it fulfills one or more of the following purposes: (1) Increases total production; (2) increases the surety of production; or (3) increases the economy of production. While a crop is being produced on fallowed land an equal acreage of land must be fallow. To produce an equal average total yield on fallowed land would require an average annual yield double that on continuously cropped land. In no case was this condition fulfilled. The second condition, increasing the surety of production, was fulfilled by the grain sorghums but not by corn. Milo on fallowed land failed completely in 1933 only and produced low yields much less frequently than on continuously cropped land. Fallowing could be considered a reasonable but not an absolute insurance against total failure. Whether, on the average, fallowing increased the economy of production is problematical. Land can be kept fallow more cheaply than it can be planted to sorghum, cultivated, and the crop harvested. Consequently yields need not be double those on continuously cropped land to achieve the same economy of production. With milo in particular, it is probable that there is little difference in the economy of production on fallowed land and on continuously cropped land. The production of some grain sorghum on fallowed land appears to be justified as an insurance in years of complete or partial failure (fig. 3). In 13 of the 30 years on the south field the yield on the fallowed plots was more than double the average yield of the continuously cropped plots. Most of the years when the fallowed land was more productive were years of partial failure when the extra feed provided would have been highly important.

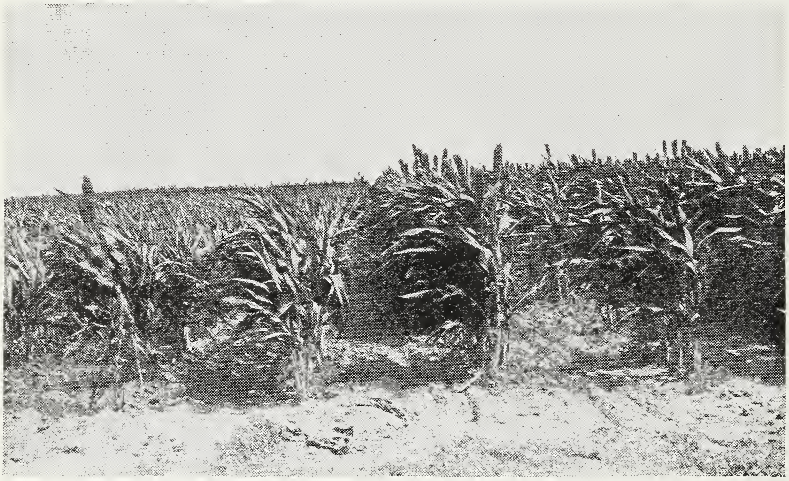

FIGURE 3.—One year in which fallow paid dividends. The plot of kafir on fallow (right) produced 30.8 bushels per acre. The plot on fall-plowed land (left) produced 5,500 pounds of stover to the acre but no grain. On the average, fallowing increased kafir grain yields by about 50 percent.

Fallowing for a row crop necessitates keeping the land bare over winter. When fallow has been properly maintained and not cultivated at times or in a manner to pulverize the soil, it does not greatly increase the hazard of soil blowing. When the surface has become pulverized, either through lack of precautions or in spite of them, fallow must be ridged in some manner to protect it during the winter. As a rule, it contains enough moisture so that tillage to prevent wind erosion is easily performed and is effective.

METHODS OF LISTING

The fact that the listing methods used in the continuous-cropping series were so much less productive than spring or fall plowing led to the starting of tests to determine whether cultivation to provide a more favorable seedbed on listed land might not result in better comparative yields. The listing methods and the methods used for comparison are as follows:

1.—Disked, surface planted.
2.—Disked, planted with furrow openers.
3.—Early spring listed, harrowed, relisted in same furrows.
4.—Early spring listed, planted by splitting ridges.
5.—Fall listed, planted by splitting ridges.
6.—Listed at planting time.
7.—Early spring disked, listed at planting.

It will be noted that methods 6 and 7 correspond to the two methods used in the continuous-cropping series.

Table 5 shows the average yields obtained from these different methods during the years 1926–38. Three sets of averages are presented. The first is an average of all years. The second represents the years 1926–29 and 1935–38. During the period from 1930–34, milo disease distributed unequally between plots introduced a factor that may have had more effect than the cultural method. In the third set of averages the year 1927 and the years 1930–34 are omitted. In 1927, plots representing methods 4, 5, 6, and 7 were replanted and did not mature grain.

Table 5.—*Average acre yields of milo grown under different planting methods during the period 1926–38 and for the same period with certain years omitted*

Item	Yield under indicated planting practice						
	1	2	3	4	5	6	7
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
Average yield, 1926–38	12.7	13.8	11.7	11.3	9.3	8.1	9.7
Average yield, 1926–38, 1930–34 omitted	13.7	15	15.1	12.1	10.7	8.8	11.3
Average yield, 1926–38, 1927 and 1930–34 omitted	13	14.2	14.5	13.8	12.2	10	12.9

Methods 6 and 7 held the same relationship to each other in this field as did similar methods in the other fields, further demonstrating the value of working the soil in the spring prior to planting. Two methods of early spring lister preparation and the two spring-disked and surface-planted plots produced yields considerably in excess of those not listed until seeding time. The plot listed in the fall and not disturbed again until relisted at seeding time was less productive than any of the plots receiving early spring cultivation.

Average results show that for the years when milo disease was not a factor, early spring listing, harrowing, and relisting in the same furrows produced yields fully as high as those of the two methods of surface planting under trial. Spring listing and splitting ridges at planting was one of the better methods except in 1927, when failure to obtain a stand from the first planting resulted in failure to mature.

Records for the south field show that during the last 30 years it has been necessary on three occasions to replant listed land in years when replanting was not necessary on surface planting. The replanting was made necessary by soil washing into the furrows and then baking, preventing emergence of the young plants.

The conclusion reached from a study of the listing methods is that the better methods of lister preparation will produce yields comparable with those on surface-planted land. The chief benefit of listing, however, will be found in economy of production and in the protection it offers against losses of soil and water rather than in actual yields.

The use of furrow openers on a surface planter in lieu of listing appears to possess some advantages. The yield was above that on land similarly prepared but planted with a surface planter. The difference in yield may not be significant, but the furrows provide a better control of weeds by cultivation.

In practice the use of less-productive methods of listing does not always depress yields to the full extent shown in these experiments. Probably the reduced early growth on such listed land is due to planting in furrows, where most of the immediately available plant food, particularly nitrates, has been pushed away. Shallow listing, practiced by many farmers, while apparently less efficient than deeper listing, probably has an advantage in that the seed is placed in a somewhat more favorable seedbed.

METHODS OF FALLOWING

The fact that row crops were much more productive on fallowed land than on continuously cropped land in the continuous-cropping work led to a study of methods of fallowing to determine whether there was not some method that would be still more productive than the one used in those tests.

The method used in the continuous-cropping series is called the standard method and consists of leaving a stubble on the ground over winter, plowing after weeds have made a start but before they have made a heavy growth (usually in the first half of June), and keeping the land clean during the remainder of the season. The methods used in comparison were those where cultivation was started earlier in order to save more moisture if possible and those started later to determine whether the cost of summer cultivation could be reduced without a loss of yield.

Methods of fallow experiments with kafir were started in 1918, and the first yields from plots on which the cultivation had been differentiated during the fallow year were obtained in 1919. Methods of fallow with milo were started in the north field in 1914, and the first yields were obtained in 1915. Irregular growth of the milo on these plots led to the duplication of this work in the west field in 1923. The first yield on differentiated land was obtained in 1924. The yield for 1924 used in calculating averages for the methods is a mean of the yields in the two fields that year. The plots in the north field were discontinued in 1925, and the yields from 1925 on are from the west field. Additional plots wherein listing was used in comparison with plowing were started in 1926.

The methods of land preparation used for fallow are as follows:

H–I. Plowed in fall after crop was removed, replowed in June, kept clean.
J–K. Plowed in fall, kept clean during next summer.
L–M. Standard method. Plowed in spring, usually about June 15; kept clean during summer.
N–O. Plowed as late as practicable, kept clean during season.
P–Q. Listed in spring, usually about June 15; kept clean.

It was contemplated that considerable time would elapse between the plowing of the L–M plots and the N–O plots. In actual practice this difference was not realized. In some years there was little distinction, and the average difference in time of plowing was just 2 weeks. The average dates of plowing of first preparation of the different fallows for kafir were as follows: H–I, November 29; J–K, November 29; L–M, June 16; N–O, June 30; P–Q, June 17.

During the same period the dates for the milo series were almost exactly the same. However, during the years 1915–18 the plowing dates of the spring-worked plots was earlier, and the average date of first spring cultivation for the whole period was about 5 days earlier than for the kafir plots.

The average yields of milo and kafir under the different methods of fallow are given in table 6. Two averages are given for milo, in order to have comparable averages of the listed and the plowed fallows.

TABLE 6.—*Average acre yields of milo and kafir grown on fallowed land prepared by different methods, 1915–38*

Crop	Period averaged	Yield under indicated methods of fallowing				
		H–I	J–K	L–M	N–O	P–Q
		Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*
Milo	1915–38	28.6	29.3	27.8	25.7	----------
Do	1926–38	30.8	31.6	30.0	25.8	30.6
Kafir	1919–38	18.0	18.9	19.6	21.3	15.7

Results with the two crops are somewhat contradictory. They indicate, however, that beginning cultivation in the fall has not been an economic practice. The small increase in yield shown by milo on the plots where cultivation was started in the fall is not enough to compensate for the increased cost of cultivation made necessary by the long fallow period. With kafir the spring cultivations were apparently superior to fall cultivations. The results appear to indicate that plowing of row-crop land can be delayed until well into June without material sacrifice of yield. Listing in lieu of plowing apparently was responsible for a decreased yield of kafir, although the milo yield was fully as high as on plowed land. However, listing is adapted to contour cultivation, which should in some years increase the water storage and resultant yields. In many years, however, the available water-storage capacity is all utilized by plowed fallows, and impounding additional moisture on the ground could not increase the quantity available to crops.

The quantity of water available to milo that can be held for a considerable period by the soil in the north field is approximately 5.7 inches. The average quantity available at planting time on the fallowed plots of milo was 5.4 inches. In some years the quantity of water available at planting time was more than 5.7 inches, because rains near planting time raised the moisture content of the soil above the quantity that it could retain for any considerable period of time. In only 8 of the 23 years that moisture records are available for the north field, however, was the available water present at planting time less than 5 inches, and 5 of the 8 years were 1934, 1935, 1936, 1937, and 1938. This demonstrates that under normal conditions the quantity of water saved by the standard method of fallowing is sufficient to utilize practically all the water-storage capacity of the soil. This is probably the reason why extending the length of the fallow period has not been effective in increasing yields. Improvements in methods of fallowing for row crops are likely to be along the line of reducing costs or creating a condition less susceptible to soil blowing, rather than in increasing yields through greater water absorption.

Fallowing, other than a small acreage as an insurance against failure, is not likely to be practiced in a section where failures have been as infrequent as at Dalhart. Since the degree of pulverization attained by the soil during the fallow period is to a considerable extent dependent on the length of time the soil is kept bare, it seems apparent that where row-crop land is to be fallowed for the subsequent growth of row crops, cultivation should be delayed until about the middle of June. The possible loss of yield that might result from this relatively late plowing is fully compensated for by a lower cost for fallow operations.

Where wheatland is being fallowed a somewhat different condition prevails. Volunteer wheat or weeds in the wheat stubble may make it necessary to start operations earlier. In this case the cultivation should begin before the weeds or wheat have made enough growth to use water rapidly.

RESULTS WITH SMALL-GRAIN CROPS

Winter wheat and winter rye have been grown on alternately cropped and fallowed land and on continuously cropped land prepared by different methods. The continuous methods used for both crops consist of early and late plowing. The early-plowed plots are plowed soon after harvest and are given enough cultivation to prevent weed growth until seeding. The late-prepared plots are left undisturbed until the first part of September and are then plowed and worked down preparatory to seeding. Two other methods of early preparation are employed with wheat, the beginning of cultivation in each being coincident with the early plowing. One plot is kept clean with a disk. The other is listed in lieu of plowing and is worked down approximately level before seeding. Spring oats are grown with only two methods of soil preparation, early plowing and alternate fallow. The average yields of the three crops under the different methods of cultivation are shown in table 7.

TABLE 7.—*Average acre yields of winter wheat, winter rye, and oats under different methods of soil preparation on continuously cropped land and on alternately fallowed and cropped land*

Crop	Years averaged	Yield under indicated method				
		Early plowed	Early disked	Early listed	Late plowed	Fallowed
		Bushels	*Bushels*	*Bushels*	*Bushels*	*Bvshels*
Winter wheat	1927–38	6.7	4.9	5.3	3.8	11.2
Winter rye	1920–38	7.1			2.4	9.0
Do	1927–38	5.2			.8	7.3
Oats	1928–38	8.5				11.7

The results show the value of early preparation of land for grain crops. Both wheat and rye on late-plowed land produced very low yields. If wheat and rye are to be grown at all, the moisture that falls between harvest and seeding must be conserved. Attempts to grow a crop after the water from summer rains has been dissipated by weeds or volunteer growth offer little possibility of success. With rye, the plot on late-plowed land produced a yield of more than 10 bushels an acre only once in 19 years. The early-plowed plot produced six yields over 10 bushels an acre during the same period. With wheat the difference is not so marked, because of the shorter term of years that wheat has been grown in its present location. This short period includes a majority of the years of total failure. In the 5 years when a crop of wheat was produced, three of the yields on early-plowed land were above 10 bushels and two were above 20 bushels an acre. The late-plowed plot had only one yield above 20 bushels and two above 10 bushels an acre. There was no single year, except those of complete failure, when the yields of both wheat and rye on early-plowed land did not exceed those on late-plowed land. Eliminating the years of complete failure, there is a differential of nearly 9 bushels of rye and nearly 7 bushels of wheat in favor of early plowing.

The other two plots of wheat on early-prepared land exceeded the late-plowed land in yield, although they did not equal the early-plowed land. They again demonstrate the benefit of early preparation. The test is not inclusive enough to attempt to determine a definite yield differential between methods, as these plots are unduplicated and are not subject to check by comparison with other crops having similar growth habits. The limited value of small-grain crops on soil of the type of that on the Dalhart station does not warrant discontinuing other work to provide space sufficient for a really comprehensive test.

Yields of both wheat and rye on fallowed land were above those on early-plowed land. The relative and actual increase in yield for wheat was above that for rye. In poor years yields were much the same. In good years, however, wheat responded to the favorable conditions much more strongly than rye and produced materially higher yields. The net result was a much greater response to fallow by wheat. The yield of wheat on fallowed land was nearly 70 percent higher than that on early-plowed land, while that of rye was less than 30 percent higher. During the 5 years in which yields of wheat were obtained on both the fallowed and the early-plowed land, the fallowed land averaged the higher by almost 10 bushels an acre. Yields were obtained in a few years on fallowed land when wheat on early-prepared land failed, but the number was not great, and the chief value of fallow lay in the production of higher yields when continuously cropped wheat did not fail.

It is probable that these isolated plots of wheat on fallowed land do not permit fallow to show to so good an advantage as it might on a larger area. Sometimes wheat on fallowed land makes enough growth so that soil blowing would not originate on it, but not enough to resist even a minor amount of blowing from adjacent plots. In such years wheat on preparations other than fallow is likely to have made a growth inadequate to cover the ground, and these plots constitute a menace to the plot on fallow.

Oats on fallow produced a yield about 30 percent higher than on early-plowed land. Six of the 10 years when oats were grown were years of total failure for both methods. In the 4 years when yields were produced, fallowed land exceeded cropped land in yield by about 9.5 bushels to the acre.

Regardless of methods, the yields on the station indicate that small-grain production is a highly speculative enterprise and one that has little to offer as a means of stabilizing agriculture.

EFFECT OF SEASON ON CULTURAL METHODS

The relative yields of sorghums and corn grown on fall-plowed, spring-plowed, and listed land have been cited and the comparative merits of the different methods discussed. The average yield for each method is the result of following that method consistently. In individual years the relative merits of the different methods may not conform to the average. In one type of year, land plowed in the fall may be most productive; in another, spring-plowed land may produce the highest yield; and in still another type listing excels. If it were possible to adopt a system of farming wherein each method was used in the particular years to which it was best adapted, average yields could be materially increased. This, of course, is not possible in its entirety, because the relative yields of the different methods are often not decided until shortly before harvest. An attempt has been made, however, to determine from past records whether the probable merits of two different methods of cultivation can be determined in advance of the time that the earlier operation should be performed. Thus, whether to plow in the fall or in the spring must be decided in advance of the time when fall plowing should be done, and whether to plow or to list in the spring must be decided in advance of the optimum time for spring plowing.

Observation of the fact that fall-plowed land has a tendency to produce higher yields than spring-plowed land in years of good production led to the study of whether the rainfall in advance of the time to plow in the fall might be a sound basis for deciding whether or not to plow. Fall plowing of land where a sorghum crop has been grown is usually done in late November or December. An arbitrary basis of 3 inches (computed to the nearest 0.1 inch) of rain during September, October, and November was selected as a division point between years when moisture had been sufficient to put the soil in good condition for plowing.

The relative yields on spring-plowed and fall-plowed land in the years receiving 3 inches or more of precipitation and those receiving less than 3 inches during these 3 months were compared. A summary of the results is shown in table 8.

TABLE 8.—*Average acre yields of milo, kafir, and corn on fall-plowed and on spring-plowed land following two conditions of autumn precipitation*

Crop and field	Yields in years with 3 inches or more of rain the preceding September, October, and November		Yields in years with less than 3 inches of rain the preceding September, October, and November	
	Fall-plowed land	Spring-plowed land	Fall-plowed land	Spring-plowed land
Milo:	*Bushels*	*Bushels*	*Bushels*	*Bushels*
South	30.4	28.5	12.4	13.3
North	26.2	23.7	9.1	11.6
Kafir:				
South	29.2	25.5	10.5	11.8
North	25.6	24.2	9.7	10.8
Corn:				
South	22.0	21.8	4.8	5.3
North	16.1	16.9	4.7	6.2

During the 30 years that crops were grown in the south field there were 16 years when the fall precipitation equaled or exceeded 3 inches, and 14 when it was less than 3 inches. In the north field the corresponding numbers in 24 years were 14 and 10.

With all crops except corn in the north field, yields on fall-plowed land exceeded those on spring-plowed land in years when the precipitation for the 3-month period prior to December was more than 3 inches. With each crop and field the average yield on land plowed in the fall under this condition was relatively better in relation to that on land plowed in the spring than in an average of all years. Apparently an advantage is to be gained by plowing in the fall in only the years when the soil is in good condition for plowing at that time.

This does not mean that fall plowing is the best in each of these years, but it indicates that the percentages are in favor of it. Analysis by individual years shows that when the precipitation was 3 inches or more, milo on fall-plowed land in the south field produced a higher yield than that on spring-plowed land in 12 of the 16 years. In the north field the yield on fall-plowed land exceeded that on spring-plowed land in 10 of the 14 years. Corresponding figures for the other crops were as follows: Kafir, 12 of 16 in the south field and 9 of 14 in the north field; and corn, 7 of 16 in the south field and 4 of 11 in the north field. Corn did not react to fall plowing in the same manner as the sorghums. In most years, however, when conditions after plowing continued favorable the fall-plowed plot produced the higher yield.

When the precipitation for the 3 months before December 1 was less than 3 inches (in most cases less than 2.5 inches), the order of yield was reversed and the yield without exception favored spring plowing. This is due to a considerable extent but not entirely to the relatively high yields on spring-plowed land in 1937.

The analysis by years shows a definite trend in favor of spring plowing in seasons following dry autumns. When the precipitation prior to December 1 was less than 3 inches, the yield of milo on spring-plowed land exceeded that on fall-plowed land in 7 of 11 years in the south field and in 6 of 7 years in the north field. Corresponding yields for other crops were 3 of 9 for kafir in the south field and 5 of 8 for kafir in the north field, and 4 of 7 for corn in the south field and 5 of 5 for corn in the north field. With all crops except kafir on the south field the chances favored spring plowing.

Presuming that the land had been plowed in the fall in years when moisture conditions were favorable to plowing at that time and in the spring in years when the fall was dry, the average yield of every crop could have been increased from a fraction of a bushel to a bushel an acre over the yield where fall plowing was practiced each year, and with the crops other than corn, fall plowing would have had an even greater advantage over spring plowing. This would have been accompanied by a reduced cost of operation, as fall plowing requires the most power and is most expensive when the soil is dry.

On the other hand, had plowing been done in the fall when the soil was dry, and in the spring when moisture conditions favored early fall plowing, the yields of milo and kafir in both fields would have been reduced considerably below the yields of continuous fall plowing, and a little below the yields of continuous spring plowing.

Knowledge that listed row crops are sometimes more productive than surface-planted row crops in drought years led to a breaking down of the years of deficient fall and winter precipitation to determine under what conditions spring plowing should be omitted. In this study it was necessary to make an artificial line of demarcation between years when the fall and winter precipitation made spring plowing appear feasible and those in which the weather continued dry past the normal date for spring plowing. An arbitrary quantity of 4 inches of precipitation during the fall and winter period (to April 30) was selected as the dividing line.

In the years when the precipitation for the fall and winter period was over 4 inches, the yields of milo and kafir on spring-plowed land exceeded those on listed land approximately three-fifths of the time. In the years when dry conditions continued through April, the yields on listed land exceeded those on spring-plowed land more than three-fourths of the time, although the average yield was not higher in all cases, owing to the relatively high yield on spring-plowed land in 1937. All indications are that if the year continues dry through April there is a materially greater chance of obtaining a crop when the land is not plowed.

With corn, listing exceeded spring plowing in yield most of the time in both groups of years. In the lower rainfall group, however, neither method offered much promise of producing a yield large enough to be of value. The maximum yield in such years was 12.4 bushels an acre, and the average yield for the two methods in such years was less than 2 bushels an acre.

The superiority of listing in dry years is undoubtedly due to the fact that listed crops make a slower early growth, develop fewer suckers, and in consequence use less moisture and survive better during an extended drought period.

With sorghums it appears probable that fall plowing on the average most frequently provides conditions under which maximum yields are possible. Conditions subsequent to plowing decide whether or not these possibilities are to be realized. If conditions do not remain uniformly favorable, the slightly less vigorous growth on spring-plowed land may be the medium of producing the highest yields (fig. 4). If conditions are very bad, the materially less vigorous growth on listed land may provide the best means of producing a yield.

It seems apparent that the methods that tend to produce the highest yields in productive years are likely to produce the lowest yields in adverse years. A scant growth is a positive advantage in a dry year.

With corn the number of good years is relatively lower than for sorghums, because corn more frequently suffers from drought during the growing season. Consequently the full possibilities for yield are seldom realized, and methods that do not provide for maximum yield are, on the average, more productive.

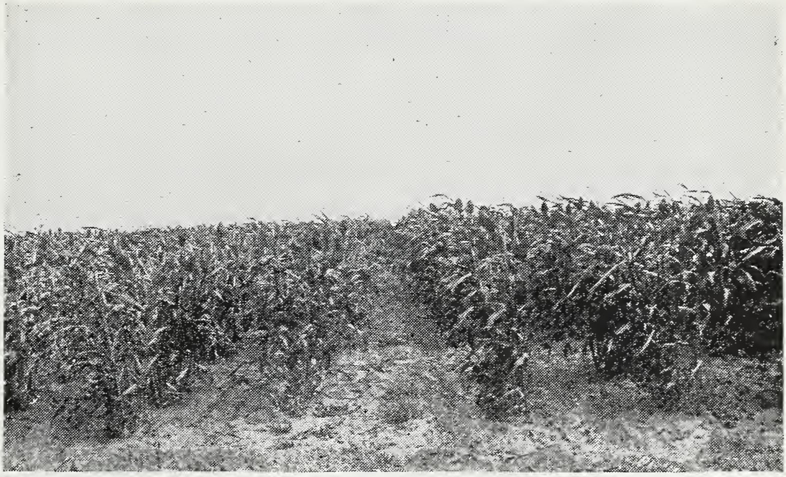

Figure 4.—In spite of appearances, the spring-plowed milo plot (left) produced a yield of 39.7 bushels an acre, while the fall-plowed plot (right) produced a yield of only 28.6 bushels an acre. The moisture available was not sufficient to carry to maturity the more vigorous growth on the fall-plowed plot.

The term "fall plowing" (or "fall-plowed") as used in this discussion is really a misnomer. By the time sorghums have been removed the fall season is over and the plowing might more accurately be designated winter plowing. The value of winter plowing cannot be due to the soil's being in a more receptive condition to receive moisture during the winter months. The low rainfall from December to March, inclusive (fig. 1), precludes the accumulation of much moisture during that period. What such plowing does is to conserve water already in the soil from fall rains, and it is probable that this could be accomplished by deferring plowing until early spring, leaving the sorghum residue on the ground as a protection against soil blowing during the winter.

While the implement of cultivation has been the plow, it is not considered that there is any particular virtue in the implement used. Any other implement that would destroy weeds, loosen and rearrange soil, and leave it in condition to absorb future rains would accomplish the same end. Any depression in yield due to ordinary listing is probably due to the planting operation that furrows the ground deeply and places the seed where the supply of immediately available plant food is low compared with surface soil. Early working with a lister, reworking, and planting by relisting the same furrows in a manner that at least approximates surface planting would undoubtedly produce comparable yields. Since the lister is the implement that is most generally used and that will probably continue to be used in the section, on account of its economy and its adaptability to large-scale operations, it is necessary to suit the cultural operations to the needs of the section.

Winter plowing after a wet autumn has been instrumental in increasing yields, but it buries a crop residue that would be of great value in protecting the soil during the winter, especially during February and March. It is probable that most of the benefits of winter plowing could be retained, and some of its disadvantages avoided, by substituting early spring preparation for winter plowing in years of ample fall precipitation. Listing, preferably on the contour, performed in late March or early April after much of the blow season is over, should prevent the soil from moving during the balance of the blow season in spite of the destruction of the crop residue. Whether it would create a soil condition as favorable for maximum yields as winter plowing is not certain, but it does appear certain that this cultivation method permits the production of good yields, and the greater economy and the erosion-prevention feature of the practice should more than compensate for the fact that maximum yields may not be realized in years when conditions continue uniformly favorable through the growing season.

In the absence of fall or winter moisture, there is no need for early working of the soil, and the crop residues can be left on the ground as a protective cover until the occurrence of rain or the commencement of weed growth makes working the soil desirable. A listing operation performed in late April or early May destroys one crop of weeds and leaves the soil in condition to absorb much of the rain that normally occurs at that period. The amount of cultivation required before seeding is thus reduced. If rainfall during the balance of the season prior to seeding is favorable, planting shallow with a lister or planting with furrow openers appears indicated. In the absence of such rains, planting deep with a lister in order to reduce the vigor of plant growth affords a better opportunity of producing a yield.

Results with Crop Rotations

Crop rotation is a method of growing the crops needed on the farm in an orderly manner that may reduce labor costs, that permits the arrangement of crops in sequences that tend to produce higher yields, and that provides the opportunity of maintaining the fertility of the soil through the regular use of soil-improving crops or the addition of organic amendments.

Labor costs are reduced because proper arrangement of crops may permit the elimination of certain cultural operations, and because crop diversification permits a better distribution of labor. Yields may be increased because some crops leave a soil condition conducive to the growth of the following crops. The effects of the different kinds of crops on one another are discussed under Crop Sequence.

CROP SEQUENCE

Crops grown at Dalhart may be divided into three major groups so far as their effect on the following crop is concerned. These general groups are (1) small grains, (2) late-harvested row crops, represented by the sorghums, (3) annual legumes, such as cowpeas, soybeans, and peanuts; and to these may be added (4) summer fallow, which is both a tillage practice and a sequence.

The effects of sequence are shown on all crops in rotation, but variations between fields and within fields make it necessary to restrict certain comparisons to locations containing crops grown under relatively uniform soil conditions. For this reason a selected group of plots in the north field is taken to show the effect of crop sequence on the yields of milo and kafir. Rotations 160 to 169 were originally designed to test the effect of crop sequence and method of cultivation on the yields of kafir and milo. However, all these rotations cannot be directly compared, because some of them have a relatively low productive capacity as a result of severe soil blowing in the early years. Rotations that appeared comparable were selected largely by the yield of cowpea hay, since this crop followed kafir or milo in each rotation where it was grown. Where no cowpeas were present in the rotation, as in 165 and 168, the behavior of crops after fallow was used as a criterion. This eliminated rotations 162, 165, and 168 from the comparison. Rotation 161 was retained, although the yield of cowpeas was lower than in other rotations, because it was the least eroded rotation in which milo followed cowpeas in this group.

The elimination of the two rotations with fallow made it appear desirable to include the continuously cropped spring-plowed and fall-plowed plots and the alternately cropped milo and kafir plots in the comparison. The effect of sequence on yield is shown in table 9. Since in most cases the spring- and the fall-plowed plots are about evenly balanced between milo and kafir, cultural differences are ignored.

TABLE 9.—*Effect of crop sequence on yields of milo and kafir in a group of rotations, 1919–38*

Crop	Preceding crop	Plots	Average acre yield	Crop	Preceding crop	Plots	Average acre yield
		Number	*Bushels*			*Number*	*Bushels*
Milo	Milo or kafir	4	20.2	Milo	Winter rye	1	25.6
Kafir	do	4	20.5	Kafir	do	1	25.4
Milo	Cowpeas	1	25.6	Milo	Fallow	1	30.3
Kafir	do	3	26.7	Kafir	do	1	28.9

The response of the two crops to the major sequences corresponded closely. Both produced the highest yield on fallowed land and the lowest when planted following a row crop. Yields after cowpeas and after winter rye were much higher than those after a row crop but were not materially different from each other. The possible value of such crops in rotations with milo or kafir must be measured in terms of their intrinsic value plus the increase in yield of the row crop.

It is true that by growing rye and cowpeas after row crops such as milo and kafir the yields are probably reduced below yields that might be obtained by growing them continuously on the same land. In these rotations, however, the reduction in yield does not appear to be great enough to offset fully the increased yield of the crops following. In sections like Dalhart, where the yields of grain sorghums are so much above the yields of competing crops, it is good practice to grow them under favorable conditions, even at the expense of reduction in the yield of the accompanying crop.

It will be noted that the difference between the yields of milo and kafir grown after row crops and the yields on fallowed land in rotations is smaller than the difference in yields following such crops and those on fallowed land in the continuously cropped series. This indicates that the inclusion of a crop other than sorghum in a rotation may have some effect on the second crop following.

CUMULATIVE EFFECTS OF SEQUENCE

While the average difference in yield between crops grown in various sequences is important, it is also desirable to know whether this difference is relatively uniform from year to year, or whether it is variable, and whether or not there is a trend toward an increasing difference in favor of one rotation over another. The effect of a legume in a rotation was determined through a study of annual and cumulative averages of milo after milo and milo after cowpeas and through a similar study with kafir.

The comparison of cumulative averages for the period 1919–38 showed a gradual increase for both row crops following cowpeas over those grown continuously that reached a climax during the years 1930 and 1931, when the maximum spread between methods was reached. Since 1932 the trend has been toward a decreased difference between the methods.

Yields for individual years explain the reason to a considerable extent. Kafir and milo grown after cowpeas evidently have a potential capacity for yield much above that of the same crops grown continuously. This potential difference is realized when growing conditions are favorable. Under very unfavorable conditions the continuously cropped plots may even exceed in yield those after cowpeas. The occurrence of so many good years during the twenties had the effect of establishing an average yield difference that could not be maintained during the series of generally poor crop years from 1932 to 1938.

Even though the difference between methods decreased during the period 1932–38, the margin of difference in favor of the crops grown after cowpeas was greater at the end of the whole 20-year period than it was at the end of the first 5 years.

Whether there has been an actual change in the comparative yield potential for the two sequences is still somewhat doubtful. Occurrence of years of a similar type in groups has such a powerful effect on cumulative yields that it obscures trends.

This is illustrated by assembling the yields for crops grown continuously and those grown after cowpeas by 5-year groups. During the first 5-year period (1919–23) milo after cowpeas exceeded milo after milo in acre yield by 4.7 bushels. During the second period (1924–28) the difference was 9.3 bushels in favor of the cowpea land. During the third period (1929–33) the difference dropped to 7.0 bushels, and during the fourth period (1934–38) it was only 1.1 bushels. This does not mean that the rotations containing cowpeas were becoming poorer. It simply indicates that the series of years included in the last period was so adverse that cowpea land had no opportunity to capitalize on its potentially higher yielding capacity. For kafir the same relative difference between yields for the different periods was noted. The difference in yield between cowpea land and continuously cropped kafir land was as follows: First period, 5.1 bushels an acre; second period, 12.3 bushels; third period, 7.8 bushels; fourth period, 3.7 bushels. As with milo, the smallest difference between methods occurred during the last 5-year period, when adverse climatic conditions were responsible for low yields on all plots. Even after 20 years it is impossible to state definitely that there is a cumulative benefit from the use of a legume in the rotation, although the immediate benefits are very evident.

To test further the question of whether there might be a cumulative benefit from the use of a legume, the differences in yield between kafir and milo on fallowed land and on cowpea land were determined by cumulative averages and by 5-year periods. The cumulative difference in favor of kafir on fallowed land over kafir on cowpea land remained nearly constant throughout the 20 years. There were some large annual fluctuations, but these were scattered throughout the 20 years. The difference in yield in favor of fallow was 2.0 bushels an acre during the first period, 1.7 bushels during the second period, 1.6 bushels during the third period, and 3.8 bushels during the fourth period. The greater difference in favor of fallow during the fourth period was due principally to the high yield on fallow in 1935.

The difference in favor of milo on fallowed land over milo on cowpea land held a similar, though not as constant, relationship. The difference by 5-year periods was as follows: First period, 3.5 bushels an acre; second period, 5.4 bushels; third period, 6.1 bushels; fourth period, 3.9 bushels. If there was any progressive change during the 20-year period, it was in favor of the fallowed land rather than the cowpea land. At least it can be stated with certainty that the use of fallow in alternate years over a 25-year period has not caused a reduction in fertility that is evidenced by crop yields.

EFFECT OF SEQUENCE ON SMALL-GRAIN CROPS

The low production and frequent failure of small grains led to their omission from nearly all rotations when the work was revised in 1918. There are two rotations, however, in which oats are grown in different sequences in comparable rotations. In rotation 58 the oats are grown on sorgo land, and in rotation 59 they are grown following cowpeas. The average yields for the 24-year period, 1915–38, are 8.7 bushels an acre in rotation 59 and 1.5 bushels in rotation 58. This difference, extreme as it is, fails to show the full difference between these sequences, because there were so many years of total failure when there was no difference between methods. In the 8 years when yields were obtained after cowpeas, the average difference between sequences was 19.7 bushels an acre. In 7 of these 8 years the yield on cowpea land exceeded the maximum yield on sorgo land. Oats production is uncertain in the extreme, and yields are obtained only in years when there is an unusual concentration of rain in April, May, and June or a heavy carry-over of water from rains the preceding fall. Even under these conditions sequence is a determining factor in yield. In only a single year during the 24-year period did oats after sorgo produce as much as 10 bushels an acre.

Oats after oats on early-plowed land and on fallowed land have been grown during a shorter period in the same field as rotations 58 and 59. The yields of oats following oats have been higher than those following cowpeas, probably because the oatland is plowed and in condition to store moisture while cowpeas are still consuming moisture. During the 11 years that oats have been grown continuously on fall-plowed land the average yield has been 9.3 bushels an acre, while the yield on cowpea land for the same period has been 6.5 bushels. In 1 year, 1930, oats on fall-plowed land produced a yield of 10.6 bushels an acre while those on cowpea land were practically a failure. Other than for this 1 year, the surety of oats production was not increased by growing them on early-plowed grain land.

Comparison of oats on plowed land with oats on fallowed land was made in the section covering cultivation methods and will not be repeated here.

RESPONSE OF MISCELLANEOUS CROPS TO SUMMER FALLOW

In most of the rotations the grain sorghums have been given the preferred place and the crops of lesser importance have been grown under less favorable conditions. To determine to what extent yields of these crops would be increased by favorable conditions, a series of rotations in which these crops are grown on fallowed land was started in 1929. One rotation to determine the yield of drilled sorgo on fallowed land had been started in 1925. A rotation in which milo replaces fallow is grown in comparison with each. The average yields from these rotations are shown in table 10.

TABLE 10.—*Average annual yields of several crops grown on fallowed land and following milo*

Crop and rotation	Years	Yield		Yield of milo[1]	Crop and rotation	Years	Yield		Yield of milo
		Total weight	Nuts				Total weight	Nuts	
Cowpeas:		*Pounds*	*Pounds*	*Bushels*	Soybeans:		*Pounds*	*Pounds*	*Bushels*
337	1930–38	2,020	--------	(2)	338	1930–38	1,383	--------	(2)
295–W	1930–38	1,267	--------	17.0	336	1930–38	744	--------	12.4
Peanuts:					Sorgo drilled:				
339	1930–38	1,881	401	(2)	304	1925–38	6,275	--------	(2)
293–W	1930–38	1,396	305	15.1	303	1925–38	2,996	--------	14.2

[1] Yield of milo in 2-year rotation with the crop specified.
[2] Fallowed.

It will be noted that all these crops respond to the more favorable moisture condition provided by summer fallow. With the possible exception of drilled sorgo, however, neither the total yield nor the surety of production was increased enough to make the growing of these crops on fallowed land economically desirable. The increase in yield of the legumes was not large enough to compensate for the loss in milo yield. Drilled sorgo on fallowed land produced a much higher yield than following milo, and some of the increased yield was in years of low production when the extra feed would have been very important. However, during the same period of years, plot B of rotation 479, on which drilled sorgo is grown continuously, produced a yield of 3,350 pounds an acre, which is more than half as high as the yield on fallowed land. Plot A of rotation 479, on which the sorgo is grown in cultivated rows, produced a yield of 4,996 pounds an acre, which is more than three-fourths as high as the yield on fallowed land.

GROWTH OF CROPS IN ALTERNATE PAIRED ROWS

The desirability of growing legumes in strips alternating with strips of crops the residues of which are more resistant to soil movement has long been recognized. On the small acreage available on the station it was not possible to conduct such an experiment on a scale large enough to give reliable information of the effect of such a practice on soil movement. Some rotations were started in 1929, however, to test the effect of this practice on the yields of crops. Alternate paired rows of kafir and cowpeas, Sudan grass and cowpeas, and milo and cowpeas were grown following milo in 2-year rotations. These rotations are comparable with those in which a solid planting of a legume is alternated with milo. The average yields of crops in these sequences are shown in table 11.

TABLE 11.—*Average acre yields of crops in rotations containing paired rows and in a comparable rotation, 1930–38*

Rotation	Crop [1]	Acre yield	Average yield of milo	Rotation	Crop [1]	Acre yield	Average yield of milo
			Bushels				*Bushels*
342	{Cowpeas	406 pounds	10.1	340	{Cowpeas	744 pounds	15.7
	{Sudan grass	1,150 pounds			{Milo	9.1 bushels	
341	{Cowpeas	661 pounds	12.4	295–W	Cowpeas	1,267 pounds	17.0
	{Kafir	6.3 bushels					

[1] The crops grown in alternate paired rows (each occupying half of the land) are bracketed.

Comparisons are somewhat difficult to make because balanced acreages of the different crops are not available, but some comparable figures may be gained. Naturally, yields of milo following paired rows of sorghums and cowpeas are lower than following cowpeas alone. This may be compensated for by the yields of crops in the paired rows.

The following comparison might be made of rotations 340 and 295–W. In rotation 295–W total yields of 17.0 bushels of milo and 1,267 pounds of cowpeas were obtained. For each bushel of milo produced there was a yield of 75 pounds of cowpeas. In rotation 340 there was a total yield of 24.8 bushels of milo but only 744 pounds of cowpeas. The increase of 7.8 bushels of milo was accompanied by a loss of 523 pounds of cowpeas. Each bushel of increased yield of milo was at the expense of a reduction of 67 pounds in cowpea yield. The indications are that the efficiency of production was not decreased and may have been increased a little by growing cowpeas and milo in paired rows.

ORGANIC AMENDMENTS

Organic amendments, in the form either of stable manure or of crops plowed under for green manure, have been tested as means of maintaining or increasing the productiveness of the soil on continuously cropped land, on crops grown in rotations, and on alternately fallowed and cropped land.

RESULTS FROM APPLICATIONS OF STABLE MANURE

The effect of manure on the grain yield of continuously cropped sorghums is perhaps best illustrated by the annual yields of milo on two plots that are similarly treated except that one is top-dressed lightly with manure each year. The yields of these two plots are shown in table 12.

TABLE 12.—*Annual and average yields of milo on two plots that are treated alike except for the addition of manure to one plot, 1925–38*

Year	Manured plot	Unmanured plot	Difference
	Bushels	*Bushels*	*Bushels*
1925	26.2	27.6	−1.4
1926	16.6	21.6	−5.0
1927	18.1	16.9	1.2
1928	37.2	24.7	12.5
1929	40.2	27.1	13.1
1930	36.6	25.2	11.4
1931	34.0	20.7	13.3
1932	16.4	7.1	9.3
1933	0	0	0
1934	5.0	8.6	−3.6
1935	19.8	24.7	−4.9
1936	9.5	16.2	−6.7
1937	23.4	29.8	−6.4
1938	4.5	6.5	−2.0
Average	20.5	18.3	2.2

The table illustrates the effect of manure on the grain yields of milo. During the very favorable years 1928–31 the manure increased yields materially. In dry years the manured plot was generally lower in production. An apparent exception to the rule was shown in 1932, but the low yield of the unmanured plot in that year was due largely to root rot. The net result was an average increase in yield of 2.2 bushels an acre during the 14 years.

When the cost of applying manure and the fact that yields in adverse years were still further reduced by the application of manure are taken into consideration, it is doubtful whether manuring has been a paying practice.

The effect of manure on the growth of stover is illustrated by a comparison of rotations 84 and 87 and rotations 88 and 89. Rotation 84 is a 3-year rotation of Sudan grass, cowpeas, and winter rye in the order named. Rotation 87 is identical except that after 1919 manure was applied to the Sudan grass. The yield of Sudan grass hay was increased on the average approximately 400 pounds an acre by the addition of manure. The increase was much the greatest in favorable years, but, in contrast with grain yields, there was no yield reduction in adverse years. The yields of cowpeas following the

Sudan grass and of winter rye following the cowpeas were not noticeably influenced, indicating that there was little residual effect.

Rotations 88 and 89 are similar to rotations 84 and 87 except that corn replaces Sudan grass. Manure is applied to the corn in rotation 89. The results for the first few years are complicated by the fact that an infestation of blueweed (*Helianthus ciliaris*) reduced yields on rotation 89 and made it necessary to discontinue the rotation for 1 year, 1919, in order to eradicate this pest. Results in later years indicate that the total weight of corn is increased by the application of manure, but that the increase is not so great as for Sudan grass. As with Sudan grass, the greatest increases in yield were recorded during productive years. In adverse years the yields of corn stover were little or no higher on the manured plot than on the one not manured. The yields of the cowpeas following the corn and of the winter rye following the cowpeas were not increased by the application of manure.

If manure is available to be applied to cropped land, it is best to apply it to a crop that is harvested for hay or stover, as the yield will be increased in a productive year and will not be decreased in an unfavorable year. Yields of grain are likely to be increased in good years but reduced in adverse years. There is no evidence of any important residual effect of manure on crops in years following the year of application.

The use of organic amendments on continuously cropped land or on land where crops are grown in rotation has one serious drawback. It promotes a vigorous growth, indicative of a higher potential yielding capacity, without providing the moisture necessary to its realization.

Recognition of this fact led to the inclusion of manure in some rotations containing summer fallow, where an attempt is made to provide the water needed to mature the crop. In rotations 298 and 302 manure is applied to land alternately fallowed and cropped to milo. In rotation 298 the manure is applied to the fallowed land, and in rotation 302 it is applied to the milo as a top dressing. Results for the 13 years that these rotations have been in operation show no appreciable difference in the yield of milo caused by the difference in time of application. Annual yields vary considerably, but neither method is consistently better in good years or poorer in adverse years.

No milo on unmanured fallow is grown in immediate proximity to these plots, but the methods of fallow studies with milo were conducted in the same field. Plots L–M of this series are handled exactly like the plots of the two manured rotations except that no manure is applied. The productive capacity of the soil of these plots appears to be a little higher than that of the manured rotations, as the average yield for the 13-year period is higher. There does not appear to be any appreciable benefit from the application of manure to fallowed land. Even in the good years the manured fallow was not better than the unmanured fallow, although possibly it approached it closer in productive years than in other years. The difference between behavior in good years and poor years, however, is hardly significant except for 1935, when the yields on manured land were very low in comparison with those on other fallows. This was one of the years when fallowed land did not store an average quantity of moisture, and the effect of manure was much the same as on continuously cropped land.

The results as a whole indicate that fertility as yet is not the limiting factor in yields on fallowed land. During the period of high yields, the plots on unmanured fallow appeared to respond to the good condition as strongly as those receiving manure. Crop conditions during the period 1932–38 were so poor that even had manure increased the productive capacity of the soil, it would not be evident, as the productive capacity cannot be realized in the absence of an adequate moisture supply.

RESULTS WITH GREEN-MANURE CROPS

Cowpeas and Sudan grass have been turned under as green manure in preparation for milo in rotations comparable with those in which milo is grown on manured fallowed land and one in which cowpeas are harvested for hay. The average yields of the crops in these rotations are shown in table 13.

TABLE 13.—*Average annual acre yields in rotations containing different forms of organic amendments, 1926–38*

Rotation	Treatment preceding milo	Yield of milo
		Bushels
302	Fallow, top-dressed	27.0
298	Fallow (milo manured)	26.7
296	Cowpeas green manure	21.9
299	Sudan grass green manure	18.5
301	Cowpeas harvested [1] (milo manured)	18.5

[1] Average yield of cowpeas, 1,465 pounds.

It is at once evident that plowing under crops for green manure has not been a paying practice. As compared with fallow, plowing under cowpeas has been a less productive practice by an average of approximately 5 bushels an acre. Since the cost of growing a green-manure crop and plowing it under is at least equal to that of maintaining a fallow, the sacrifice in yield has not been compensated for in any degree by economy of production.

The difference in yield between fallowed land and green-manured land is probably due to the difference in water content. Cowpeas and Sudan grass are not usually ready to plow under until late August or early September. By that time they have used most of the water from the summer rains. The difference in water content due to the fact that fallow is accumulating water at a time when the green-manure crop may be removing stored water is sufficient to account for the difference in yield.

Sudan grass was less efficient than cowpeas as a green-manure crop. This may be due in part to the fact that Sudan grass makes a heavier vegetative growth and consequently leaves the soil drier. Whatever the reason, land where Sudan grass has been plowed under is materially less productive than land where cowpeas have been plowed under.

Milo after cowpeas that were harvested for hay produced a yield equal to that on green-manured Sudan-grass land, but 3.4 bushels an acre lower than where the cowpeas were turned under. This difference in milo yield was compensated for by a yield of 1,465 pounds of cowpea hay to the acre. The reduction in the yield of milo may be partly due to moisture, as the cowpeas for hay were not usually harvested until about 2 weeks after those for green manure had been plowed under. The greatest difference in yield between the two methods, however, was in the more productive years, when moisture should not have been so strong a limiting factor as in most years.

Winter rye was grown as a green manure in rotation 82 in the north field. Winter rye has an advantage over cowpeas and Sudan grass in regard to time of plowing, as it usually is ready to plow under in May, which leaves a longer period for moisture conservation after plowing. Just what effect this has on yields has not been determined, as the other green-manured plots are not comparable, because the rye was grown on a severely eroded land.

The location of rotation 82 on eroded land makes it valuable for the purpose of determining whether it has been at all effective in building up eroded soil. To determine this, it is compared with rotation 168, in which kafir is grown on summer-fallowed eroded land. The difference in average yield between the kafir in the two rotations is not important, since the plots may not have suffered the same degree of erosion. Whether the plowing under of a green-manure crop has caused a change in the relative fertility of the two rotations is important. The average yields of kafir grain and total weight by 5-year periods for the two rotations are shown in table 14.

Table 14.—*Average acre yields of kafir grain and kafir total weight, by 5-year periods, on eroded fallowed land and on eroded land where a green-manure crop had been turned under, 1919–38*

Period	Kafir grain			Kafir total		
	Rotation 168, fallow	Rotation 82, rye, green manure	Difference	Rotation 168, fallow	Rotation 82, rye, green manure	Difference
	Bushels	*Bushels*	*Bushels*	*Pounds*	*Pounds*	*Pounds*
1919–23	22.6	20.6	2.0	5,987	5,480	507
1924–28	27.7	27.0	.7	7,000	7,410	−410
1929–33	17.9	21.3	−3.4	4,076	4,162	−86
1934–38	12.3	10.9	1.4	3,960	3,490	470

The comparative yields indicate that while there is a probability that the land where rye has been turned under is improving somewhat in comparison with the other plot, the change has been limited in scope and is not commensurate with the effort expended. The fact that the plot on fallowed land was proportionately better during the last 5-year period than during the two periods preceding does not mean that a change in favor of the green-manured rotation has not taken place. Conditions during the period 1934–38 were so adverse that lack of fertility was an asset rather than a liability. Annual results are not indicative of any material cumulative change, however, since comparative yields within each 5-year period fluctuate widely.

The whole study of organic amendments indicates that in this section there is a rather delicate balance between crops, climate, and soil. Increase in the amount of immediately available plant food through the use of organic amendments has in general increased the potential yielding capacity of the crop, but lack of water has prevented the potential yield from being realized in any but favorable years. In unfavorable years no increase in stover yields has resulted and grain yields have generally been depressed.

Organic amendments applied to fallow where water in excess of that on cropped land has been made available have not had the favorable results anticipated. Fallowed normal land appears to have the fertility necessary to produce high yields, and further increases in yield through the addition of organic matter have not resulted. Even on summer-fallowed land water remains the limiting factor, and crops have made a growth vigorous enough to use the available water.

Building up eroded land through organic amendments has been a slow, costly, and uncertain process. Preventing severe erosion, when possible, is far less expensive.

GROWTH OF CROPS ON ERODED LAND

Mention has been made of the lower production of a small portion of the north field, due probably to severe erosion in the early years. The soil in these locations is not sterile, as it would be in sections of higher rainfall where most of the fertility is located in a much thinner surface layer. Neither has the soil retained its full capacity to produce good yields, although in the absence of more fertile soil located close to it this might be assumed. The fact that wind-eroded land with deep soil has not been ruined for agricultural purposes is highly important. The conclusion that it has not been hurt at all is hardly warranted, as evidenced by yields on the Dalhart station.

A concrete picture of the result of injury by wind erosion as shown by crop yields is made possible by comparing yields on the eroded land with yields of the same crop on land that has suffered no appreciable loss. Such a comparison is offered in table 15. Annual yields of milo after cowpeas and after fallow on eroded and noneroded land give the opportunity of noting the effects of these preparations in different years. Two sets of plots are used in order to compare differences after fallow where stored water is available to the crops with differences where a crop is grown each year. In this particular instance the milo on cropped land is grown after cowpeas and should produce higher yields than in less favorable sequences.

The yields of milo on normal land fluctuated much more violently than the yields on eroded land. In favorable or normal years they were generally much higher. In very adverse years they were lower, but not by as many bushels. The milo on normal land apparently was able to respond to favorable conditions and produce high yields. On the eroded land the upper limit of yield in favorable years was evidently fixed by fertility. Even under the best of conditions about 30 bushels an acre appeared to be the upper limit of yield. When yields on eroded land were near their maximum the yields on normal land were generally from 40 to 50 bushels.

In the adverse set of years from 1934 to 1938, the better vegetative growth of milo on the normal land had a depressing effect on the yield of milo grain. For this period the yield on both fallowed land and cowpea land was materially greater on the eroded than on the normal land. As was the case with cultural methods, soil conditions that increased the potential yielding capacity were, in the absence of sufficient water, responsible for greater suffering by and greater injury to the crop.

TABLE 15.—*Yields of milo grown in two sequences on normal and on wind-eroded land, 1919–38*

Year	Milo on fallowed land			Milo on cowpea land		
	Normal land, plot C or D	Eroded land, rotation 165	Difference	Normal land, rotation 161[1]	Eroded land, rotation 162	Difference
	Bushels	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
1919	45.4	20.1	25.3	45.2	23.2	22.0
1920	33.9	16.7	17.2	34.3	24.0	10.3
1921	34.7	21.4	13.3	31.7	20.3	11.4
1922	25.3	16.3	9.0	21.9	20.2	1.7
1923	36.4	17.9	18.5	25.0	18.8	6.2
1924	36.2	18.6	17.6	29.1	14.1	15.0
1925	40.3	16.2	24.1	32.1	22.2	9.9
1926	35.2	23.3	11.9	32.1	20.5	11.6
1927	44.5	15.5	29.0	36.7	5.2	31.5
1928	46.4	29.0	17.4	45.7	28.6	17.1
1929	52.1	29.5	22.6	50.0	28.8	21.2
1930	51.9	31.4	20.5	46.7	28.1	18.6
1931	44.3	33.4	10.9	36.7	31.7	5.0
1932	29.0	6.7	22.3	13.4	11.0	2.4
1933	0	0	0	0	0	0
1934	.2	7.2	−7.0	.3	4.0	−3.7
1935	25.5	25.7	−.2	10.9	23.6	−12.7
1936	4.8	12.8	−8.0	1.7	8.4	−6.7
1937	9.5	17.4	−7.9	11.7	21.9	−10.2
1938	10.6	8.3	2.3	6.6	9.6	−3.0
Average	30.3	18.4	11.9	25.6	18.2	**7.4**

[1] Not entirely normal, but much less eroded than rotation 162.

The average difference in yield between eroded and normal land was high and is evidence of the fact that on soils of the type of that in the north field the net result of serious soil removal is a lowered productive capacity that is responsible for a much lower production over a series of years.

Fallowed normal land produced materially higher yields than cowpea land, because the moisture supply enabled it to realize more of its potential capacity for yield. Fallowed eroded land produced yields but little higher than those on cowpea land, probably because fertility rather than water limited the yields on fallow in many of the years.

The extent of permanent injury caused by wind erosion on this field cannot be regarded as typical of all wind-eroded soils. Observations have shown that shallow soils are much more badly damaged, in some cases being rendered unfit for further cultivation. On the other hand, some heavier soils show little or no reduction in yield from a considerable amount of wind erosion. The limit on production placed by precipitation is so much below the limit placed by fertility that a considerable loss of soil can take place without reducing the yield. The yields reported here, however, show that there is injury on soils like that in the north field and emphasize the necessity of guarding against soil losses.

STRIP CROPPING

The acreage of land on the station does not permit the establishment of experiments in strip cropping. When the new rotations in the west field were laid out in 1929, however, the different rotations were purposely arranged so that some of the effects of strip cropping could be observed. This set of rotations contains fallows and annual legumes, which may leave surfaces susceptible to blowing They were so arranged that milo was grown on every third plot on each series each year, thus leaving a protective residue for a covering on one-third of the land. On one of the series in each year additional protection was afforded by the plots containing paired rows of milo, kafir, or Sudan grass alternating with paired rows of a legume. The value of strip cropping as a means of reducing wind erosion has been apparent. These rotations have been in the path of soil moving across the station from adjacent fields. The milo has held moving soil each year. It has not greatly reduced soil movement across the plots having surfaces more susceptible to wind erosion, but the amount of erosion on these other plots has been far below what would have occurred had they been arranged in solid blocks. Observation on these plots and on land where sorghum varieties have been grown in a solid block indicate that a short Sudan grass stubble is one of the most desirable types of crop residue where soil drifting is taking place. It protects the surface and accumulates a small amount of the drifting soil, but not enough to form hummocks or to interfere seriously with cultivation.

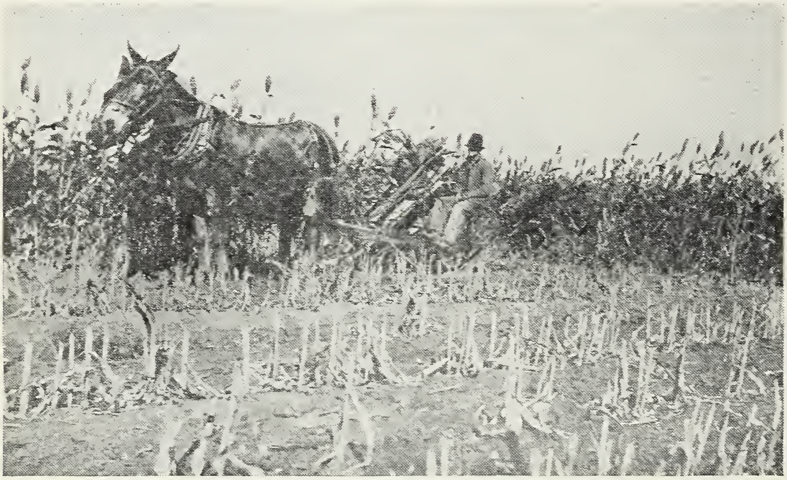

FIGURE 5.—Harvesting Sunrise kafir for forage. The stubble left is tall enough to prevent loss of soil, but not tall enough to accumulate hummocks.

In areas where heavy movement of soil takes place, a sorghum stubble tall enough to hold a limited quantity of soil and allow the remainder to move across it unimpeded is preferable to a residue tall enough to cause accumulation of soil in hummocks or in depths great enough to make future tillage difficult. With sorghums harvested for forage this is done by leaving a stubble long enough to accomplish this purpose (fig. 5). With such crops as milo, where the stalks are generally left standing, it is desirable to break down these stalks during the early winter, to prevent the accumulation of hummocks. The broken-down stalks are more effective in protecting the whole surface than are standing stalks.

The value of strip cropping in areas subject to wind erosion does not lie in the complete stopping of soil movement across strips. It lies in the fact that there is no cutting but rather an accumulation on the resistant strips, which prevents deep cutting on the more susceptible land between.

Under ordinary conditions a field cropped in strips, with proper handling of the land between strips, is able to control soil movement originating in the field. Where soil from adjacent land is moving onto a field, it is better to allow the soil to move across it with as little damage as possible than to create unmanageable accumulations by attempting to check all soil movement.

SOIL MOISTURE

Knowledge that moisture was likely to be the controlling factor in crop production led to the beginning of studies of soil moisture in 1908. These were designed particularly to determine whether differences in yield brought about by differences in cultivation were due to the quantity of moisture conserved or to other factors. In the early years moisture determinations were made on several of the row crops, as well as on spring wheat. It soon became evident that the moisture reactions of the different row crops were much the same, and work on row crops other than milo was discontinued and the work on milo strengthened. No moisture determinations were made on a small grain during the period 1917–27. Since 1928 determinations have been made at monthly intervals on winter wheat plots Nos. 1 to 6. The determinations on milo have been more frequent and consistent than on other crops, and discussion of the effect of moisture on milo production will form the bulk of the discussion on soil moisture.

Soil-Moisture Studies with Sorghums

Moisture determinations on four plots of milo were made throughout the period 1908–38. In 1908, determinations were made to a depth of 3 feet only. It became evident that year that this depth was not sufficient to cover the zone of root development. Since 1909 the depth of the regular determinations has been 6 feet. During the period 1909–14 occasional determinations were made to a depth of 8 feet, but they were discontinued when the limited scope of the changes in moisture content at depths greater than 6 feet became evident.

Determinations were made on the south field during the period 1908–15 and on the north field during the period 1914–38 except for 1918, when labor shortage made it necessary to dispense with these determinations. Since 1920, determinations on milo have been made at approximately weekly intervals throughout the life of the crop, and these afford an unusual opportunity of studying the use of water by a crop.

LABORATORY-DETERMINED CONSTANTS OF THE MILO PLOTS

The texture of a soil determines its moisture-holding properties to a considerable extent. The moisture equivalent, as developed by Briggs and McLane (*2*), is a laboratory-determined constant for expressing the soil texture. It represents, in percentage of the dry weight of soil, the quantity of water that it will hold against a force of 1,000 times gravity. At Dalhart and other stations it has been used as a means of showing differences between plots and between fields.

Table 16 shows the average moisture equivalent by foot sections of the milo plots in the two fields. It shows that although the soil occupied by the milo plots in the two fields is classed as belonging to the same type, there is a material difference in texture.

TABLE 16.—*Moisture equivalents by foot sections of the milo plots in the south and the north fields at the Dalhart Field Station*

Depth (feet)	South field	North field	Depth (feet)	South field	North field	Depth (feet)	South field	North field
	Percent	*Percent*		*Percent*	*Percent*		*Percent*	*Percent*
1	17.8	14.2	4	24.7	20.0	7		13.6
2	21.1	20.7	5	24.5	18.6	8		13.2
3	23.6	20.9	6	24.2	15.4			

The soil in the south field is heavier than that in the north field in the first foot section. In the second foot section they are about equal. Below the depth of 2 feet the soil of the south field becomes heavier, with the maximum moisture equivalent shown at a depth of 4 feet. Below that depth there is little change. The soil of the north field reaches its maximum moisture equivalent in the third foot, where it is only a little higher than in the second. Below the third foot the soil becomes increasingly sandy. The seventh and eighth foot sections are lighter than the surface soil.

Table 16 shows in general the difference of the soil in the two fields. Smaller differences exist in many cases between plots close together in the same field.

FIELD-DETERMINED CONSTANTS

The quantity of water available to crops that a soil will hold within reach of their roots is a vital factor in crop production. It is fixed by two limits. The upper limit is the quantity of water that the soil will retain, and it is called the field carrying capacity. The lower limit is the point to which the particular crops can reduce the water content of the soil, and it is called the minimum point. The difference between the two is the available water held by the soil.

The field carrying capacity, as here determined, is an average of the water content of the soil at times when it was wet enough to permit water movement through it, but not so wet as to have any material quantity of water that would be quickly lost by evaporation or drainage. The water not available to the crop, the upper limit of which is the minimum point, represents the quantity of water left in the soil by milo crops that were suffering for water. Data on the minimum point are more abundant and consequently more reliable than those on carrying capacity, but at least in the north field data on both are abundant enough to insure accuracy to within a small fraction of 1 percent. The figures for the field carrying capacity of the south field are a little less accurate for most foot sections and much less accurate for the sixth foot section. Data sufficient to establish a carrying capacity for the sixth foot were found on one plot only.

Both points were determined in all four plots on each field and are used in the study of individual plots. To illustrate the difference between fields, averages for the four plots in each of the two fields are presented in table 17.

The conversion from percentage of moisture to inches of water was based on the volume weight of the soil. The volume weight was determined from the weight of cores taken in making the moisture determination. Core weights for several seasons were used to establish the average core weight.

TABLE 17.—*Field carrying capacity, minimum point, and available water by individual foot sections of the soil of 2 fields at the Dalhart Field Station*

Depth (feet)	North field				South field			
	Field carrying capacity	Minimum point	Available water		Field carrying capacity	Minimum point	Available water	
	Percent	*Percent*	*Percent*	*Inches*	*Percent*	*Percent*	*Percent*	*Inches*
1	13.8	5.7	8.1	1.27	15.2	6.4	8.8	1.22
2	16.2	9.3	6.9	1.10	16.5	9.1	7.4	1.20
3	14.3	8.3	6.0	1.01	16.4	10.3	6.1	1.00
4	13.6	8.1	5.5	.91	16.0	10.8	5.2	.88
5	12.7	7.8	4.9	.83	15.5	11.1	4.4	.73
6	10.4	7.0	3.4	.59	15.6	11.0	4.6	.76
Total inches	13.39	7.66		5.71	15.35	9.56		5.79

Table 17 shows some interesting facts. The quantity of available water held in 6 feet of soil was approximately the same for both fields in spite of the differences in soil texture. The average difference between fields was smaller than differences between plots in the same field. The field carrying capacity of the south field was higher, but the minimum point of unavailable water was also higher. The total capacity for storage of available water was approximately 5¾ inches for each field. The soil will hold a greater quantity of available water, however, for a temporary period.

Another interesting fact is that as the distance from the surface is increased, the quantity of water available to milo that each successive foot of soil holds becomes smaller. This is due in part to the fact that, particularly at depths lower than 3 feet, the soil is less completely occupied by roots. It is also due partly to the fact that the carrying capacity of a soil in proportion to its moisture equivalent is higher near the surface than at lower depths.[3]

AVAILABLE WATER AT PLANTING TIME AND YIELDS OF MILO

The water content of each plot of soil at planting time was determined by subtracting the nonavailable water from the total quantity of water present. The quantity of available water present at planting time on each plot and the yield of that plot are shown in table 18.

Even a casual inspection of the table shows that in general high yields of milo are associated with large quantities of water in the soil at planting time and that low yields are associated with low water storage. The correlation between the quantity of water present at planting time and the yield is 0.75, which indicates a very high degree of relationship. The high correlation is due principally to the fact that low water storage at planting time has seldom been corrected by favorable conditions after planting. Minor differences in quantities of water have not been closely associated with differences in yield, indicating that most of these differences may be and probably are due to experimental error.

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[3] Unpublished data in Division of Dry Land Agriculture.

TABLE 18.—*Quantity of available water at planting time and the yields of milo on two plots continuously cropped (A and B) and on two plots alternately fallowed and cropped (C–D) in the north field at the Dalhart Field Station, 1914–38* [1]

Year	Water at planting time			Yield of milo		
	Plot A	Plot B	Plots C–D	Plot A	Plot B	Plots C–D
	Inches	*Inches*	*Inches*	*Bushels*	*Bushels*	*Bushels*
1914	5.5	6.9	7.2	51	48	50
1915	6.0	5.3	6.4	43	42	55
1916	1.6	1.2	5.9	13	5	23
1917	.8	1.9	3.3	0	0	13
1919	6.2	(2)	5.8	38	(2)	45
1920	6.5	6.2	7.7	31	28	34
1921	4.0	4.8	5.8	24	22	35
1922	3.8	4.5	5.7	16	15	25
1923	5.0	5.6	5.3	24	24	36
1924	6.4	6.2	5.5	15	27	36
1925	4.0	4.2	4.1	26	29	40
1926	5.6	5.6	6.0	23	25	35
1927	1.6	1.3	4.7	21	26	45
1928	4.5	4.7	5.3	28	40	46
1929	5.2	5.5	5.9	31	41	52
1930	2.7	2.6	5.2	26	31	52
1931	4.7	4.9	5.3	30	27	44
1932	3.3	3.1	6.7	10	7	29
1934	1.8	1.4	2.0	1	0	0
1935	1.0	.8	3.7	3	3	26
1936	2.6	2,4	4.8	1	0	5
1937	3.6	2.5	2.6	25	8	10
1938	1.6	1.7	2.6	7	3	11
Average	3.83	3.79	5.11	21.2	20.5	32.5

[1] No moisture determinations were made in 1918. In 1933 the soil was so dry at the normal planting time for milo that planting was not done until rain in August. This year is omitted.

[2] No planting determination was made on plot B in 1919.

The table also indicates that moisture, while the most important, is not the only controlling factor in crop production. The increase in the yield of milo on fallowed land over that on cropped land in many years appears to be out of proportion to differences in the quantity of water conserved.

It is not believed that the water in the soil at planting time is any more valuable than the same quantity of water taken into the soil at some later period. Past records show, however, that the rainfall after planting time has been less variable than rainfall before planting time. Consequently the presence of a greater quantity of water in the soil at planting time in 1 year generally meant that there would be a greater quantity of water for the growth of the crop. It might be compared to money in the bank. It is something already there and not something that must be put aside from an income that may not be more than sufficient for current needs.

A similar study was made of available water content at planting time and the yields of milo during the period that moisture determinations were made on the south field. Most of the years included in this study were prior to the period included in the study of the north field. The correlation between water content at planting time and yield was 0.81, indicating that the relationship was at least as strong during the period 1909–15 as for the period included in the north-field study.

In both fields there was a stronger correlation between water at planting time and yield on the cropped plots than on the fallowed plots. This was probably because fallowed land was filled to capacity in a great many of the years, and there was less opportunity for differences in water content to show their effect on yields.

Regardless of reasons or explanations, it is an established fact that the size of the milo crop is determined to a considerable extent before the seed is put into the ground.

AVAILABLE WATER AT PLANTING TIME AND YIELDS OF KAFIR

Correlations between water at planting time and the yield of kafir on spring-plowed land, fall-plowed land, and fallowed land during the period 1909–15 were determined. The correlation between water at planting time and yield on the cropped plots was much the same as for milo. The combined correlation for the two cropped plots was 0.75 for grain and 0.70 for total weight. On the fallowed land, however, there was no positive correlation between the water at planting time and the yield. The reason was apparent. In all but 1 of the 7 years under consideration the soil at planting time held all the water that it was capable of holding for any considerable time. Since the moisture was so uniform at planting time it is obvious that differences in yield would necessarily be due to differences in conditions after planting.

RATE OF USE OF WATER BY MILO DURING THE PERIOD OF RAPID GROWTH

It is common knowledge that the yield of milo is determined to a considerable extent by the development of the crop during the heading period. Lack of water during this critical period may postpone or prevent heading, or shortage of water after heading may reduce the yield below that promised by the growth of the crop. Water sufficient to carry the crop through this period seems to be essential to good production. For this reason the data during this period were studied critically to determine the rate of use of water by the crop in different years, whether any particular rate was essential to the production of a good crop, and to what extent the needs of the crop were met by current rainfall.

To answer these questions, the use of water by the crop was studied for approximately a 5-week period beginning in late July or early August and covering the first week in September. This includes the period of rapid growth prior to heading, the heading period, and a short period after heading when the grain is being formed. This comprises the period of heaviest water use, and it is during this period that the size of the crop that will be harvested is largely determined. Part of the data from this study are presented in table 19.

That the final yield of milo is determined largely by the rate of use of water during this period is at once evident. High yields have been associated with water use above the average. Low yields have almost invariably been associated with low water use. The low use does not indicate a low need for water. It indicates that there was not sufficient water present to supply the needs of the crop. It appears evident that with adequate water the daily rate of use would probably exceed 0.15 inch per day, and that maximum yields require a greater rate of use.

TABLE 19.—*Total and daily use of water by milo during periods beginning about August 1, number of days in periods, and yields of milo on 3 plots at the Dalhart Field Station during certain years from 1920 to 1938*

Year	Total use of water by milo, 5-week period			Days	Daily rate of use			Yield of milo grain		
	Plot A	Plot B	Plot C–D		Plot A	Plot B	Plot C–D	Plot A	Plot B	Plot C–D
	Inches	*Inches*	*Inches*	*Number*	*Inches*	*Inches*	*Inches*	*Bushels*	*Bushels*	*Bushels*
1920	6.33	5.39	4.96	35	0.18	0.15	0.14	31.0	27.6	33.9
1921	4.30	3.85	5.00	33	.13	.12	.15	24.0	22.4	34.7
1922	3.08	3.76	3.98	35	.09	.11	.11	16.4	14.8	25.3
1923	7.38	8.49	7.48	39	.19	.22	.19	23.8	23.8	36.4
1924	4.01	4.25	4.52	36	.11	.12	.13	15.0	26.7	36.2
1925	6.15	7.11	6.50	36	.17	.20	.18	25.9	28.6	40.3
1926	3.58	3.04	5.09	36	.10	.08	.14	23.4	25.0	35.2
1927	5.77	7.06	7.12	37	.16	.19	.19	20.7	25.9	44.5
1928	4.64	6.15	6.85	42	.11	.15	.16	27.6	39.8	46.4
1929	5.10	6.08	6.01	35	.15	.17	.17	31.4	41.4	52.1
1930	3.62	4.02	6.02	35	.10	.11	.17	26.0	30.7	51.9
1931	6.51	4.97	6.36	36	.18	.14	.18	30.3	27.2	44.3
1932	3.35	3.12	4.62	36	.09	.09	.13	9.7	6.7	29.0
1934	1.80	.79	2.15	35	.05	.02	.06	.5	.3	.2
1935	2.83	2.81	4.60	35	.08	.08	.13	2.8	2.9	25.5
1936	2.40	1.04	2.59	35	.07	.03	.07	.9	0	4.8
1937	4.76	2.92	2.85	35	.14	.08	.08	25.3	7.8	9.5
1938	3.21	2.79	3.55	35	.09	.08	.10	7.1	3.2	10.6

One point evident in the data is the drastic reduction in yield in years when the rate of use was less than 0.10 inch per day. In such years, yields were generally less than 10 bushels per acre.

The relationship between the rate of use during this period and the yield is shown by correlations. These are 0.792 for plot A, 0.747 for plot B, 0.921 for plot C–D, and 0.793 for all plots. The relationship is even higher than that for water at planting time and yield.

To what extent is this need for water met by the precipitation? This question is answered by the precipitation records. The average precipitation for the periods shown in table 19 is 2.80 inches, or an average of 0.078 inch per day. This quantity of water is seldom sufficient to produce a yield of as much as 10 bushels an acre. Production of a good crop usually requires a rate nearly twice as high. This explains the value of water stored in the soil. In some years precipitation is adequate to meet the needs of the crop and a good yield is obtained with little reduction in soil water. In some years stored water is adequate to produce a yield in spite of low rainfall. These years are not common, however. In most years all the water from the precipitation and from that held in storage is insufficient to meet the full requirement of the crop, and the yield is reduced to the extent that the combined total fails to meet the needs for maximum production. Under such conditions the importance of the stored water is evident.

Correlations between the quantity of water supplied by reduction in stored moisture and the yield, and for precipitation during the 5-week period and the yield, show how the yield depends upon both. For plot A, the correlation between reduction in stored water and yield was 0.256, and that between precipitation and yield was 0.400.

As stated before, the correlation for the sum of the two and the yield is 0.792. This shows that a much closer relationship exists for the two together than for either one alone. The lower correlation for the stored water is probably due to the fact that in the few years of ample rainfall during the critical period, stored water in the soil was not removed.

Corresponding figures for plot B were 0.257 for reduction in soil water and yield and 0.646 for precipitation and yield; and for plot C–D, 0.157 for reduction in stored water and yield and 0.656 for precipitation and yield. As with plot A, correlations for either item alone with yield were much lower than the correlation for the sum of the two.

It will be noted that plot C–D, which had the highest content of stored water, shows the lowest correlation between stored water and yield. This is because soil-moisture conditions were generally good, and the precipitation thus had a greater opportunity of being the controlling factor. On the other plots, lack of stored water sometimes seriously reduced yields in spite of a precipitation above the average.

Granting that the use of water during the period of rapid growth determines the yield, why is water in the soil at planting time so important? Would not the same quantity of water stored after seeding time be just as valuable? The answer is "Yes," but the storage of material quantities of water after planting is unusual. The period of water accumulation is largely over by the time milo is planted, and the rainfall from planting time to August 1 is seldom large enough to compensate for evaporation from the soil and use by the young milo crop.

On plot A, for example, there were only 2 years of the 18 when as much as 1 inch of water was stored between planting time and the first of August. In many years there was a loss, and in a few years the loss was heavy. In most years, however, the precipitation just about balanced the loss from the soil, and the water in storage at the end of July was practically equivalent to that present at planting time. The average for all years was a loss of half an inch for the period.

This further explains the value of water present at planting time. Its value is based on the fact that most of it is still in the soil available for use during the critical period in August. As mentioned before, it is like money in the bank. It is there ready for use when needed. The average small loss for the period from planting time to August 1 indicates that the quantity of water stored at planting time is exceedingly likely to be all the stored water that will be present during the critical period.

The soil-moisture content at planting time shows that the size of the crop to be harvested is determined to a considerable extent before the seed is put into the ground. This indicates the possibility of adjusting spacings in the row and between rows to conform to the moisture supply.

PENETRATION OF RAINS

Little detailed study of the penetration of rains was made, but the determination of the water content of the soil at weekly intervals through the growing season afforded numerous opportunities to note the depth of soil to which change in moisture content took place after rains. Except in one year, no attempt was made to measure the exact depth to which water from different sized rains penetrated. It is doubtful whether material for such a study is available. The depth to which a given quantity of water will penetrate a given soil is governed by many factors. Among these are the quantity of water already in the soil, the manner in which the rain falls, whether or not there is run-off, and climatic conditions following the rain. It would require an immense volume of data for similar conditions before, during, and after rains of even approximate magnitude to be repeated frequently enough to furnish reliable information.

Determinations made after rains exhibited one characteristic so frequently that it could hardly be due to the experimental error always present in sampling. Particularly when the soil was dry or approaching dryness, the occurrence of a substantial rain appeared to cause two types of increase in water content. One change was of considerable magnitude and was confined to 1- or 2-foot sections near the surface. It could be safely attributed to the depth to which the soil was actually wetted. The other change was of small magnitude and generally extended to the full depth of the determination. This type of change was not always evident, but it occurred in such a majority of cases as to indicate that there is probably some translocation of water from wet to dry soil, probably through milo roots. The work of Breazeale (*1*) would indicate this possibility. Whether or not this is the correct interpretation, it seems evident that some change in water content takes place that is not due to direct percolation. It is probably not great enough to be of agricultural importance, but it is mentioned because such a condition has not been plainly evident in determinations made with small grains.

These studies of soil-moisture records at Dalhart have not been exhaustive, but they show a few of the important relationships between water and soil.

SORGHUM VARIETIES AND DATES AND RATES OF PLANTING

Extensive experiments with sorghum varieties and with dates and rates of planting have been conducted at Dalhart. Much of this material has been published elsewhere, and the discussion in this circular will be confined to presenting a few of the pertinent facts that have been established.

Adapted Varieties of Sorghum

Variety tests of grain and forage sorghums have been conducted at Dalhart since 1919. The results from 1919 to 1931 were published in detail in a bulletin of the Oklahoma Agricultural Experiment Station (*8*), and yields of forage sorghums from 1919 to 1932 were published in a bulletin of the Texas Agricultural Experiment Station (*10, p. 26*). The following statements regarding varieties are from the Oklahoma bulletin (*8, pp. 20, 25*).

> For grain production in region 1 [the three counties of the Oklahoma Panhandle], Dwarf Yellow milo, Santa Fe kafir (Dwarf kafir), and Reed kafir have given the highest yields. * * * Dwarf Yellow milo is the highest and the most dependable yielder of the grain sorghums. This variety seems to be rather

> peculiarly adapted to the soil and climate of the region. The length of the growing season, the distribution of the rainfall, and the character of the soil meet the requirements for this crop. Because of the ability of Dwarf Yellow milo, locally known as "maize," to adapt itself to different spacings in the row, it is better able than other grain sorghums to produce maximum yields according to the amount of moisture available during the growing season.
>
> * * * Dwarf hegari will compete with Dwarf Yellow milo in yield only when planted towards the latter part of the planting season, the 15th to 20th of June.
>
> For combine purposes or machine heading Wheatland milo is the most promising variety. A few seasons of preliminary work indicates that Wheatland milo is rather a close yield competitor of Dwarf Yellow milo, and lodging tests indicate a higher resistance to lodging than other varieties. Wheatland milo matures a few days later than Dwarf Yellow milo. Beaver milo lodges more readily than Wheatland and does not yield with Dwarf Yellow milo.
>
> Varieties recommended for combination grain and forage production, or for bundle feed, are Sunrise kafir, Santa Fe kafir, Dwarf hegari, and Early Red kafir. Sunrise kafir is a tall, slender, early, and high yielding kafir. While Sunrise kafir makes its highest yield of grain when planted the first of June, it matures easily when planted the middle of the month and a better quality of feed is secured. For bundle feed the later planting is recommended. The later planting also assists in preventing lodging. Santa Fe gives a satisfactory quality of bundle feed. It does not lodge as freely as Sunrise kafir and does not produce as palatable a stover.
>
> Dwarf hegari is the most popular, and deservedly so, of the grain sorghums for bundle feed. For the best results, for both grain and bundle feed, Dwarf hegari should be planted around the middle of June. In the earlier plantings it is difficult to secure a stand; neither does the plant grow so vigorously when planted early. Dwarf hegari produces an excellent quality of forage and is a standard by which other combination grain and forage sorghums may be compared.
>
> Early Red kafir probably should be ranked second to Dwarf hegari as a combination grain and forage sorghum. The yields of grain are usually not as high as Santa Fe kafir, which has the same growing season, but the quality of the forage is better. Several communities prefer this grain sorghum for bundle feed.

Little additional information regarding yields has been obtained since the foregoing statements were written, because of adverse conditions and the incidence of disease. The widespread appearance of pythium root rot, however, materially changed recommendations for milo varieties.

Dwarf Yellow milo, Wheatland, Beaver, and Fargo are all highly susceptible to the disease. A selection of Dwarf Yellow milo, Finney,[4] that is highly resistant to root rot has been developed and is now being widely distributed. This selection is almost identical with Dwarf Yellow milo in all visible characters and appears to possess the same capacity to yield. It was until recently the only variety of milo for which seed was available that could be recommended where root rot occurs. The appearance of this disease in widely separated localities indicates that within the next few years the area where varieties not resistant to root rot should be grown will be sharply restricted. Rapid progress, however, has been made in developing resistant strains of other varieties, and it appears probable that strains of at least some of these varieties and resistant strains of Dwarf Yellow milo developed by the Texas Agricultural Experiment Station will be available by the time the need becomes generally acute.

Several varieties of sorghums not mentioned in the discussion cited have evidenced, during the drought years, qualities that make them valuable under certain conditions.

Sooner[5] or Sixty Day, a very early variety of milo, has been used as a catch crop and has produced good yields when conditions necessitated planting at dates later than those from which ordinary varieties would mature. Its continued usefulness, however, depends upon the availability of disease-resistant strains now under development, as it is highly susceptible to root rot.

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[4] A disease-resistant strain developed at the Garden City branch station of the Kansas Agricultural Experiment Station.

[5] A variety developed at the U. S. Southern Great Plains Field Station at Woodward, Okla.

Early kalo,[6] a milo-kafir hybrid, appears to have at least as great an ability to produce good yields when planted late and is resistant to root rot.

An early red kafir, now named Sedan,[7] appears to have a good capacity for yield under adverse conditions and the ability to mature when planted late. Its yielding capacity under favorable climatic conditions has not been fully determined.

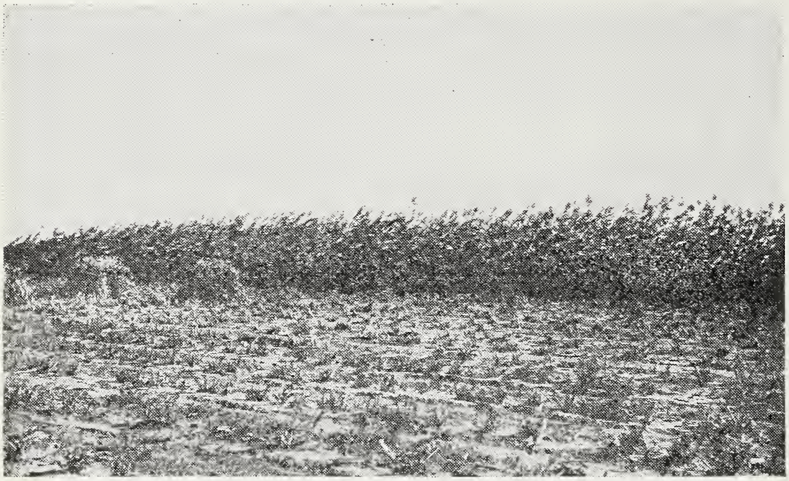

Figure 6.—A heavy crop of Honey sorgo. The forage sorghums are comparatively sure crops and produce high yields when conditions are favorable. Milo stubble is shown in the foreground.

The sorghums grown for forage alone were not mentioned in the discussion in the Oklahoma bulletin (*8*). Among the varieties that have proved adaptable are Atlas, Honey (fig. 6), Leoti Red, Sumac, and African Millet. Leoti Red has been used in the crop rotations because it is the only one of these that can be depended on to mature seed. It has the disadvantage of being more susceptible to head smut than most varieties. All these varieties are dependable feed producers.

Of the broomcorn varieties, Scarborough appears to be the best adapted. It has produced a larger yield of high-quality brush than the other varieties tested.

Planting Dates for Sorghums

Experiments on planting dates for several varieties of sorghum were conducted during the period from 1922 to 1926 and have been reported in detail (*9*). In subsequent years all varieties were planted on three dates in a combined date-variety test. The yields from these tests are not presented in detail, but some generalizations regarding date of planting can be made.

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[6] A variety developed at the Fort Hays branch station of the Kansas Agricultural Experiment Station.
[7] Selected and purified at the Dalhart Field Station.

With all of the more important varieties of sorghums, the optimum time of planting appears to be in June. On the average, sorghums planted as early as the middle of May make less growth, produce smaller heads, and require a longer growing period than those planted in June. The average yields of sorghums planted June 1 are a little lower than those planted June 15, but the difference is not great enough to make delay in planting desirable if conditions early in June are favorable for planting. Plantings made late in June sometimes mature and produce yields as high as those from earlier plantings. There is, however, the danger that they will not mature, and there is no opportunity to replant if a poor stand is obtained.

If the highest yields are to be produced, heading should start about the second week of August and be fully completed by about August 20. Very early-maturing sorghums, such as Sooner or Sixty Day milo, produce higher yields when planted early in July than when planted in June.

The results at Dalhart show that the ordinary grain and forage sorghums should be planted in June and that planting should be started early enough to insure its completion by June 20. By June the soil temperature is usually high enough to give prompt germination and rapid early growth, and there is still opportunity to replant with the same variety where stands are unsatisfactory. When replanting must be done late in June or early in July it is preferable to use an early-maturing variety. Experience at Dalhart has shown that if heading is not complete by about August 25, sorghums seldom mature fully, even though frost may not occur until later than the usual date.

Maximum production of sorghums appears to demand prompt germination, an uninterrupted growth through heading, and a heading period that is as late as is consistent with maturing the crop in advance of frost. This combination of conditions is more commonly experienced when planting is made between June 1 and 20 than when made earlier or later.

The foregoing statements hold true for the sorghums as a whole, but where more than one kind of sorghum is being grown, planting may be varied according to variety. For example, Texas Blackhull kafir should be planted earlier than milo, and hegari, like milo, is best planted toward the latter part of the planting season.

RATE OF PLANTING SORGHUMS

Rate-of-planting tests for Dwarf Yellow milo and Dwarf kafir were conducted during the period 1919–26, and results have been reported (*9*). They showed that for milo a rather wide range in plant spacing in the row could be employed without materially influencing the yield. While the highest average yield was obtained from plants 6 inches apart in the row, spacings as wide as 24 inches showed little reduction in yield. Free-tillering crops such as milo are able to accommodate their growth to the moisture available and suffer little reduction in yield from wide spacings in the row, even under favorable conditions.

The slightly smaller yield is compensated for by greater ease in harvesting, as the heads on the wider spacings are fewer in number but larger.

The period during which this experiment was conducted was one of yields above average. It is probable that under average conditions the yields from wide spacings would have at least equaled those from the closer spacing. The recommended spacing distance for milo plants is 18 to 24 inches in the row. With this as an objective, planting can be done with the assurance that an actual stand somewhat thinner or thicker than that desired will not materially affect the yield. In very adverse years, spacings wider than those recommended, even up to 3 feet apart in the row, may be desirable.

The spacing results with Dawn kafir differ from those with milo. In years of medium production, little variation in yield was shown between spacings ranging from 6 to 24 inches. In good years, however, kafir on the thinner spacings was unable to tiller sufficiently to take full advantage of the favorable conditions, and yields were lower than in the closer spacings. In the one adverse year the yield on the 24-inch spacing was highest. A spacing rate of 12 to 18 inches in the row is recommended in years when conditions at planting are favorable. Under adverse conditions a spacing rate of from 18 to 24 inches in the row seems advisable.

For the forage sorghums, such as Sumac and Atlas, a spacing of less than 12 inches in the row is desirable. Equally good yields and better quality of forage are obtained from spacings of 6 to 12 inches than from wider spacings. Since forage rather than grain production is desired, the size of head is not important.

The best spacing for broomcorn appears to be about 9 inches in the row. Wider spacing results in a coarser brush with more goosenecks. Closer spacing has likewise produced a smaller proportion of good-quality brush.

Hegari, which is grown for grain as well as forage, needs a wider spacing in the row than the forage sorghums. This is accomplished by using approximately the same quantity of seed to the acre as for the forage sorghums, as the seeds are larger and more subject to rotting in the soil. Hegari tillers freely and is able to adapt itself to a considerable range of spacings.

The accepted rate of seeding for Sudan grass is about 5 pounds to the acre when planted in cultivated rows and 15 pounds when drilled.

The general statement can be made that the spacing rate for sorghums depends on the tillering habits of the different varieties and the purpose for which they are grown. The spacing of plants in the row of sorghums grown for grain should be governed to a considerable extent by their tillering. As wide a spacing as will permit the utilization of the available moisture is desirable. The total yield may not be increased by the wide spacing, but the heads will be larger, and there will be a better opportunity of producing grain in adverse seasons. Varieties grown for forage require closer spacing, since the total weight of dry matter produced generally decreases as the spacing rate is increased. Both the yield and the quality of fodder are better in the narrower spacings. Varieties grown for both grain and fodder should be spaced closer than those grown for grain alone.

SUMMARY AND CONCLUSIONS

This circular reports results in crop production obtained at the United States Dry Land Field Station at Dalhart, Tex., during the years 1908–38. The station is located near the eastern edge of the Canadian-Cimarron High Plains (western division) at an altitude of approximately 4,000 feet. Results at Dalhart are applicable to portions of Texas, Oklahoma, and New Mexico.

The soil on the cropped land is for the most part classed as deep, moderately sandy, diversified cropland. It is high in fertility except on certain areas where much of the A horizon has been removed by wind erosion.

The average annual precipitation is 17.50 inches, and the average seasonal precipitation is 13.72 inches, or 78 percent of the annual. The average evaporation from a free water surface during the 6-month period April-September is 51.931 inches. Wind velocities are highest in March, April, and May, and it is during these months that the problem of wind erosion is most acute.

Wind erosion has been a serious problem ever since the station was established. Cultural methods and methods of handling crop residues that were developed after soil losses in earlier years have proved effective in controlling the soil on the station. Soil blowing originating on neighboring fields has been a serious hazard during the last few years. Soils of the type constituting the Dalhart station must be carefully handled if wind erosion is to be checked.

The section and the soil represented by this station are particularly adapted to the growth of sorghums. Grain sorghums, forage sorghums, and broomcorn are all productive. Small grains are relatively unproductive, although good yields of winter wheat and winter rye are obtained in some years. Cowpeas appear to be the best adapted of the annual legumes. Sorghums are so well adapted that it seems apparent that crop production must be centered in them.

Yields of sorghums are influenced by the time that land preparation is commenced and by the planting method used. Early preparation is effective in producing high yields when the fall or winter precipitation has been above normal. In the absence of such precipitation, better average yields have been obtained by beginning land preparation in late April or early May.

Listing for the first time at planting has produced average yields materially lower than those from surface planting, but in adverse years yields from such listing are often highest. By adapting the time of land preparation and the planting method to the precipitation, it is possible to obtain higher average yields than from the continuous use of any one practice.

Results with winter wheat and winter rye show much higher yields when preparation is started shortly after harvest than when it is delayed until shortly before planting. If these crops are to be grown, early preparation should be practiced.

Fallowing increased the yields of all crops, but with most crops the increase was not sufficient to justify the use of much fallow in the cropping system. Tests of methods of fallowing showed that no advantage is gained by starting cultivation of row-crop land for fallow earlier than June of the fallow year.

Listing for the first time at planting produced much lower average yields than listing early, working, and relisting or splitting the ridges at planting. Yields from the latter methods compare favorably with those on surface-planted land.

Differences in crop sequence resulted in material differences in yield. The effect of a crop in a rotation was confined largely to the crop immediately following. Cumulative benefits from the inclusion of legumes in the rotation were very small.

Stable manure increased yields of stover in good years and did not decrease them in adverse years. It increased yields of grain materially in good years but decreased them in adverse years. No noticeable benefit was shown to crops in the rotation other than the one to which manure was applied.

Crops following green-manure crops were less productive than those following summer fallow throughout the period covered by the experiments.

Land in the north field that had suffered severe wind erosion appeared to have had its crop-producing capacity materially reduced. The smaller vegetative growth was responsible for its producing higher yields than normal land in adverse years. Yields in good years and average yields for the whole period of years were much lower than those from noneroded land. Green-manure crops have not been effective in restoring the fertility of eroded land.

The quantity of available water in the soil at planting time had a determining effect on yield. Precipitation during the growing season was seldom high enough to correct low water storage at planting time and it was seldom low enough to cause failure when the quantity of water present at planting time was above normal.

An uninterrupted use of water throughout the heading period appeared to be essential to high yields. During a 5-week period beginning about August 1, the use of at least 0.10 inch of water a day appeared to be essential to the production of even a fair yield. A rate of use of at least 0.15 inch a day appeared to be necessary for the production of high yields. Inasmuch as the precipitation during this period is seldom high enough to provide this quantity of water, good yields are dependent upon an adequate supply of stored moisture to help carry the crop through this critical period. The chief value of having a large quantity of water in the soil at planting time is that it is still in the soil available for use during the heading period.

Adapted varieties, dates of planting, and rates of planting are discussed briefly.

Methods of land preparation and planting that produce high yields in good years are likely to produce yields below average in adverse years. Adapting a crop to the season may be done in three ways: (1) By governing the time of commencing operations by the precipitation, (2) by adapting the planting manner to the moisture present at planting time, and (3) by adapting the planting rate to the water present at planting time. Proper selection of practices should permit the production of average yields above those that would be received from the use of any one method.

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APPENDIX

DETAILED TABULAR DATA

TABLE 20.—*Monthly, seasonal, and average evaporation at the Dalhart Field Station, 1908–38*

Year	April	May	June	July	August	September	Seasonal totals, April–September
	Inches	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*	*Inches*
1908	6.920	10.918	12.072	9.182	9.888	7.950	56.930
1909	8.526	9.901	10.890	11.685	10.565	7.835	59.402
1910	8.540	8.183	12.020	11.626	8.822	8.441	57.632
1911	7.562	9.900	12.373	9.707	10.899	8.769	59.210
1912	8.214	10.237	8.475	11.103	9.131	6.750	53.910
1913	7.687	10.063	8.714	12.697	10.771	6.338	56.270
1914	6.535	7.813	10.256	8.837	9.059	8.227	50.727
1915	5.777	8.075	8.740	9.262	7.919	6.853	46.626
1916	6.597	11.088	10.367	11.022	9.597	7.136	55.807
1917	8.561	9.074	11.697	10.997	9.607	7.460	57.396
1918	6.371	10.640	9.157	11.229	10.854	6.318	54.569
1919	5.583	6.994	7.482	9.865	8.291	6.933	45.148
1920	7.000	8.050	8.737	7.877	7.622	6.954	46.240
1921	6.826	7.425	6.912	7.655	7.351	8.304	44.473
1922	6.397	7.955	9.091	9.582	9.914	6.807	49.746
1923	6.161	7.472	7.430	8.140	8.337	5.817	43.357
1924	7.307	7.465	9.407	9.089	9.077	6.387	48.732
1925	7.389	7.041	9.721	9.043	6.602	5.573	45.369
1926	4.618	6.314	6.960	8.503	9.269	6.953	42.617
1927	7.266	10.727	9.529	9.081	6.636	5.174	48.413
1928	6.610	7.236	7.546	7.545	7.213	7.430	43.580
1929	7.301	6.427	8.285	9.836	8.180	6.291	46.320
1930	7.524	9.273	9.967	11.162	9.358	8.067	55.351
1931	5.193	7.355	10.620	10.528	7.731	8.153	49.580
1932	7.320	8.340	7.925	10.414	9.855	6.747	50.601
1933	7.573	10.549	13.081	12.400	10.326	8.473	62.402
1934	7.926	9.684	11.557	13.395	10.884	7.679	61.125
1935	7.925	7.336	9.719	11.174	9.571	6.437	52.162
1936	8.189	8.236	9.638	10.391	10.242	6.752	53.448
1937	7.722	9.602	10.432	11.226	10.595	7.323	56.900
1938	7.742	9.201	9.692	10.706	11.608	6.880	55.829
Average	7.092	8.664	9.629	10.160	9.218	7.136	51.931

TABLE 21.—*Monthly and annual mean temperatures at the Dalhart Field Station, 1908–38*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual average
	°F.	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*
1908	------	------	------	53	61	72	72	73	66	52	37	32	------
1909	34	35	39	50	59	72	77	76	64	52	43	23	52.0
1910	32	29	50	54	59	72	78	73	70	54	43	34	54.0
1911	40	32	47	54	65	78	76	75	73	53	40	26	54.9
1912	25	32	35	51	64	68	77	74	61	55	44	31	51.4
1913	31	29	41	53	66	75	79	79	62	51	47	30	53.6
1914	41	36	44	52	61	74	74	73	70	54	45	36	55.0
1915	31	37	37	56	59	70	74	71	67	56	45	36	53.3
1916	32	40	50	51	64	72	78	75	67	54	39	29	54.3
1917	31	36	42	52	57	72	79	74	68	53	47	34	53.8
1918	26	39	48	50	64	75	78	76	63	58	39	28	53.7
1919	21	33	44	52	61	69	76	75	70	53	40	35	52.4

TABLE 21.—*Monthly and annual mean temperatures at the Dalhart Field Station, 1908–38*—Continued

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual average
	°F.	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*	*°F.*
1920	34	38	44	49	62	69	75	71	68	56	38	35	53.3
1921	37	38	48	52	64	69	74	75	71	59	45	38	55.8
1922	29	35	42	53	62	73	78	80	72	56	43	37	55.0
1923	40	32	40	54	62	71	77	75	66	51	42	29	53.3
1924	32	37	34	53	58	74	75	76	65	57	45	26	52.7
1925	31	41	49	57	65	76	78	72	68	49	43	34	55.3
1926	33	42	41	48	62	70	75	76	68	57	42	33	53.9
1927	37	39	43	57	68	71	76	72	66	57	47	28	55.1
1928	36	34	46	51	63	69	77	73	67	56	39	33	53.7
1929	32	26	44	55	60	72	76	75	65	55	33	36	52.4
1930	22	44	40	59	62	73	77	76	69	54	44	34	54.5
1931	34	41	39	51	60	75	77	73	73	57	42	36	54.8
1932	30	44	38	55	65	70	78	76	66	54	43	25	53.7
1933	37	31	46	51	64	78	80	76	72	58	46	42	56.8
1934	37	39	45	57	69	77	83	80	66	59	46	37	57.9
1935	38	40	49	54	58	73	80	77	65	56	41	35	55.5
1936	31	30	47	54	65	75	79	79	67	53	42	37	54.9
1937	25	35	41	54	66	73	79	80	70	57	42	34	54.7
1938	35	37	48	54	64	74	78	80	69	59	39	35	56.0
Average, 1909–38	32	36	43	53	63	73	77	75	68	55	42	33	54.2

TABLE 22.—*Monthly and annual average wind velocity at the Dalhart Field Station, 1908–38*

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual average
	M. p. h.	*M. p. h.*	*M. p. h.*	*M. p. h.*	*M. p. h.*	*M. p. h.*	*M. p. h.*	*M. p. h.*	*M. p. h.*	*M. p. h.*	*M. p. h.*	*M. p. h.*	*M. p. h.*
1908	------	------	------	8.2	10.1	10.8	7.9	7.1	6.5	8.8	6.2	6.7	------
1909	8.0	11.1	9.1	11.2	9.5	8.7	7.6	7.7	7.1	8.6	7.0	6.7	8.5
1910	7.8	8.9	8.3	9.5	9.3	9.3	6.8	6.1	6.7	6.5	5.6	6.3	7.6
1911	9.4	8.1	8.1	9.9	10.8	8.8	7.9	7.1	7.0	7.3	11.0	7.1	8.5
1912	5.7	9.1	10.5	10.8	9.0	7.1	7.3	7.0	7.4	7.2	7.5	6.8	8.0
1913	8.6	6.1	9.1	7.4	6.1	3.7	11.0	7.4	7.5	8.6	8.4	7.3	7.6
1914	7.4	8.6	9.4	10.7	9.0	8.0	4.1	4.7	6.2	6.3	5.2	5.6	7.1
1915	7.2	6.5	7.3	6.8	7.7	6.6	6.4	4.5	5.9	5.0	6.4	7.0	6.4
1916	7.1	6.0	9.2	9.5	9.8	8.7	6.9	7.5	7.5	7.7	7.5	7.7	7.9
1917	7.5	8.4	8.4	11.0	9.9	9.4	8.0	7.0	6.6	8.4	7.3	6.5	8.2
1918	7.8	9.9	9.2	10.0	10.2	6.5	7.4	7.0	6.9	6.2	6.3	7.1	7.9
1919	4.7	7.1	7.8	8.9	7.5	6.2	6.0	3.8	5.4	5.6	5.5	5.3	6.2
1920	5.8	6.1	8.7	9.7	7.5	6.3	4.7	5.4	5.3	6.5	6.0	7.2	6.6
1921	6.4	6.9	8.4	8.9	8.3	6.3	4.7	4.2	6.5	6.6	4.8	6.3	6.5
1922	6.3	8.1	9.3	8.0	6.7	5.3	5.8	4.8	5.6	5.3	6.7	5.7	6.5
1923	5.7	6.4	7.5	8.2	8.2	6.6	4.3	4.2	4.3	6.2	4.3	7.0	6.1
1924	5.5	6.7	7.0	7.8	6.0	5.9	5.9	4.6	4.5	5.1	4.8	5.7	5.8
1925	5.4	6.3	7.3	7.4	6.3	6.1	4.8	3.4	4.4	4.8	4.3	5.7	5.5
1926	5.4	7.4	7.8	7.2	6.4	4.7	4.4	3.9	6.2	5.3	5.9	5.7	5.9
1927	6.3	7.0	8.6	7.7	7.1	6.7	4.8	3.9	5.1	3.7	4.5	4.3	5.8
1928	4.5	5.9	6.5	8.9	6.6	6.3	4.6	4.5	4.8	6.3	6.5	5.8	5.9
1929	6.8	7.0	8.6	8.9	8.8	5.8	5.5	3.8	6.0	5.2	8.1	4.4	6.6
1930	6.1	5.9	7.1	6.4	7.9	6.8	5.7	4.7	5.1	5.3	6.3	5.4	6.1
1931	4.7	6.5	9.2	8.2	7.2	5.4	5.1	3.8	5.0	5.0	5.0	5.9	5.9
1932	6.5	6.2	7.8	8.5	6.5	5.1	4.6	4.2	4.9	5.8	5.6	5.7	6.0
1933	5.7	6.7	8.9	8.9	8.4	7.0	6.0	6.0	6.5	5.0	5.7	5.2	6.7
1934	6.3	7.7	7.7	7.9	7.6	7.1	6.2	6.0	7.0	5.2	6.5	5.7	6.7
1935	5.2	7.6	8.8	10.3	9.6	6.6	5.4	5.1	5.1	5.4	5.2	4.6	6.6
1936	5.5	6.3	7.3	8.1	7.7	5.6	5.1	4.4	6.3	6.5	6.2	5.9	6.2
1937	6.3	7.9	9.7	9.0	8.1	6.8	4.8	5.0	4.8	5.3	4.7	5.6	6.5
1938	6.2	5.9	8.5	10.8	9.5	7.2	5.1	5.4	4.0	5.3	6.7	6.1	6.7
Average, 1909–38	6.4	7.3	8.4	8.9	8.1	6.7	5.9	5.2	5.9	6.0	6.2	6.0	6.7

TABLE 23.—*Varieties of the different crops used in the crop rotations for the years specified*

Crop	Variety	Years
Milo	Standard	1908–25.
	Dwarf Yellow	1926–33.
	Finney	1934–38.
Kafir	Blackhull	1908.
	Standard Blackhull	1909–26.
	Dawn	1927–28.
	Dwarf Blackhull	1929–37.
	Sedan	1938.
Winter wheat	Blackhull	All years except 1928.
	Turkey	1928.
Winter rye	Common	All years.
Corn	Channing Red	1908, 1910–18.
	Native White Dent	1909.
	Mexican June	1919, 1922, 1923.
	Surecropper	1920, 1921, 1924–27.
	Yellow Dent	1928–38.
Sorgo	Red Amber	1909–19, 1921–23.
	Sumac	1920, 1924.
	Colman	1925.
	Honey	1926–27.
	Leoti Red	1928–38.
Oats	Burt	1908–18.
	Texas Red	1919–26.
	Kanota	1927–38.
Cowpeas	Brabham	1914–17, 1925–27, 1930–32, 1934, 1936–38.
	Early Buff	1918–19, 1933.
	Groit	1928–29, 1935.
	Whippoorwill	1920–23.
	Taylor	1924.
Peanuts	Spanish	1918–20, 1923–25, 1928.
	Tennessee Red	1921–22, 1926–27, 1929–38.
Beans	Mexican	1918–26.
	Pinto	1927–38.
Soybeans	A. K	1930–38.

TABLE 24.—*Yields of milo grain, kafir grain and total weight, and corn grain in the south field on land continuously cropped by different methods, and on land alternately cropped and fallowed, 1908–38*

Crop and plot	Preceding crop	Tillage method	Acre yield							
			1908	1909	1910	1911	1912	1913	1914	1915
Milo, grain:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Milo	Spring plowed	35.0	3.3	26.4	5.9	39.7	0	51.7	38.8
B	do	Fall plowed	27.8	2.8	26.6	19.1	28.6	0	55.5	35.3
F	do	Listed	19.1	3.8	50.3	23.6	22.4	0	48.4	18.3
C–D	Fallow	Fallowed	27.4	14.7	69.0	27.8	52.4	10.3	45.3	43.8
Kafir, grain:										
A	Kafir	Spring plowed	0	0	18.7	0	0	0	39.2	33.7
B	do	Fall plowed	0	0	30.0	9.3	0	0	44.0	30.2
F	do	Listed	0	0	55.0	19.2	9.7	0	17.3	16.7
C–D	Fallow	Fallowed	0	0	75.5	22.5	29.8	20.8	37.8	53.0
Kafir, total:			*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
A	Kafir	Spring plowed	4,700	6,250	9,540	1,550	6,000	2,400	9,450	8,700
B	do	Fall plowed	4,010	4,020	11,940	3,450	5,500	1,800	10,400	7,400
F	do	Listed	4,140	5,500	15,570	7,050	4,530	750	6,300	4,900
C–D	Fallow	Fallowed	4,480	9,310	22,840	11,950	11,290	7,250	8,500	9,300
Corn, grain:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Corn	Spring plowed	0	0	15.1	0	10.6	0	31.6	42.8
B	do	Fall plowed	0	0	8.6	0	7.4	0	35.6	37.1
F	do	Listed	0	0	25.7	12.4	21.0	0	25.1	28.2
C–D	Fallow	Fallowed	0	0	25.7	2.8	23.0	0	30.9	65.3

TABLE 24.—*Yields of milo grain, kafir grain and total weight, and corn grain in the south field on land continuously cropped by different methods, and on land alternately cropped and fallowed, 1908–38*—Continued

Crop and plot	Preceding crop	Tillage method	Acre yield							
			1916	1917	1918	1919	1920	1921	1922	1923
Milo, grain:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Milo	Spring plowed	9.0	0	7.1	47.9	33.4	16.0	25.9	26.2
B	do	Fall plowed	16.0	0	5.7	48.7	35.7	28.9	32.1	24.1
F	do	Listed	12.8	8.8	16.2	32.9	27.8	25.0	37.4	10.9
C–D	Fallow	Fallowed	39.8	23.8	23.6	58.8	36.2	34.5	35.5	46.7
Kafir, grain:										
A	Kafir	Spring plowed	15.5	0	14.0	34.2	21.7	26.5	27.8	26.2
B	do	Fall plowed	13.8	0	14.3	38.7	23.3	29.2	26.5	26.7
F	do	Listed	5.8	4.2	9.5	31.3	20.7	26.3	25.3	26.8
C–D	Fallow	Fallowed	21.0	6.8	13.3	33.3	29.6	21.8	26.2	47.0
Kafir, total:			*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
A	Kafir	Spring plowed	5,850	2,000	3,670	5,460	5,850	5,000	5,050	6,550
B	do	Fall plowed	5,500	1,900	2,800	6,630	6,100	5,190	5,100	7,750
F	do	Listed	3,200	1,900	1,880	5,330	4,890	4,560	4,400	6,050
C–D	Fallow	Fallowed	10,100	2,460	3,030	6,445	4,450	4,000	5,650	12,050
Corn, grain:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Corn	Spring plowed	0	0	0	17.3	23.3	22.9	12.6	18.8
B	do	Fall plowed	0	0	0	18.7	22.7	25.7	12.3	18.8
F	do	Listed	0	4.9	0	18.3	29.6	16.4	15.1	24.1
C–D	Fallow	Fallowed	0	4.9	0	21.0	25.9	32.1	13.9	18.4

Crop and plot	Preceding crop	Tillage method	Acre yield							
			1924	1925	1926	1927	1928	1929	1930	1931
Milo, grain:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Milo	Spring plowed	16.4	35.3	29.7	24.8	38.6	41.2	34.7	27.9
B	do	Fall plowed	24.3	37.8	24.0	33.4	38.8	45.5	40.9	19.3
F	do	Listed	10.3	21.0	22.9	0	34.8	15.5	15.3	8.6
C–D	Fallow	Fallowed	27.8	49.1	43.6	42.1	64.5	76.4	49.1	42.4
Kafir, grain:										
A	Kafir	Spring plowed	19.2	36.3	30.2	18.8	32.2	30.3	35.0	25.7
B	do	Fall plowed	35.7	39.2	26.2	25.2	37.8	39.7	37.3	33.3
F	do	Listed	11.8	32.5	25.8	0	29.7	15.5	21.2	32.3
C–D	Fallow	Fallowed	38.3	61.2	41.0	24.7	53.8	59.7	45.8	44.7
Kafir, total:			*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
A	Kafir	Spring plowed	5,200	8,100	4,650	4,060	5,100	5,250	4,950	4,600
B	do	Fall plowed	5,650	8,300	4,250	5,900	6,000	6,800	5,300	5,250
F	do	Listed	5,450	8,350	4,800	2,250	5,950	3,300	4,400	5,750
C–D	Fallow	Fallowed	7,600	15,100	7,200	7,350	8,950	10,450	6,850	6,450
Corn, grain:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Corn	Spring plowed	28.6	37.1	22.4	15.9	35.6	22.1	28.9	20.7
B	do	Fall plowed	25.7	35.7	20.0	15.3	39.9	26.6	33.9	21.7
F	do	Listed	30.7	34.1	24.7	10.1	31.1	22.9	24.3	21.7
C–D	Fallow	Fallowed	28.6	48.6	31.4	16.0	51.9	45.1	34.7	26.9

TABLE 24.—*Yields of milo grain, kafir grain and total weight, and corn grain in the south field on land continuously cropped by different methods, and on land alternately cropped and fallowed, 1908–38*—Continued

Crop and plot	Preceding crop	Tillage method	Acre yield							
			1932	1933	1934	1935	1936	1937	1938	Average, 1909–38
Milo, grain:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Milo	Spring plowed	12.9	0	4.8	8.6	0.5	34.7	0.5	21.4
B	do	Fall plowed	19.5	0	4.1	9.3	0	4.1	0	22.0
F	do	Listed	4.1	0	6.7	11.2	7.2	50.3	1.6	18.3
C–D	Fallow	Fallowed	28.1	0	3.3	34.5	4.0	29.8	4.8	35.4
Kafir, grain:										
A	Kafir	Spring plowed	23.7	0	5.7	8.7	1.0	42.7	2.2	19.0
B	do	Fall plowed	25.8	0	5.8	9.0	0	16.2	.7	20.6
F	do	Listed	5.8	0	7.3	13.7	6.5	37.8	7.8	17.2
C–D	Fallow	Fallowed	26.7	0	6.8	43.7	9.3	44.5	12.1	31.7
Kafir, total:			*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
A	Kafir	Spring plowed	4,000	0	1,700	2,950	3,000	7,350	2,000	4,874
B	do	Fall plowed	4,450	0	1,700	4,200	1,150	4,450	1,900	5,026
F	do	Listed	2,850	0	2,000	4,650	3,750	6,050	2,200	4,619
C–D	Fallow	Fallowed	4,800	0	2,700	7,700	5,850	8,150	3,600	7,713
Corn, grain:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Corn	Spring plowed	9.6	0	0	.6	0	6.7	0	14.1
B	do	Fall plowed	10.9	0	.3	.4	0	2.1	0	14.0
F	do	Listed	10.7	0	.3	4.1	.4	8.7	0	14.8
C–D	Fallow	Fallowed	11.3	0	.3	7.9	.9	5.0	0	19.1

TABLE 25.—*Yields of milo grown under different methods of cultivation and crop sequence on the north field, 1914–38*

Plot or rotation	Preceding crop	Tillage method	Acre yield							
			1914	1915	1916	1917	1918	1919	1920	1921
			Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Milo	Spring plowed	[1] 50.7	43.1	12.9	0	12.1	37.6	31.0	24.0
B	do	Fall plowed	[1] 47.6	42.2	5.3	0	8.8	47.5	27.6	22.4
E	do	Subsoiled	[1] 50.3	43.1	8.8	0	14.0	49.7	30.3	24.8
F	do	Listed	[1] 43.4	29.3	14.8	7.6	15.0	21.7	19.8	17.4
G	do	Disked and listed	[1] 44.0	29.5	8.8	6.2	12.9	19.3	17.9	20.0
A′	do	Spring plowed	------	------	------	------	------	------	------	------
H′	do	Spring plowed and manured.	------	------	------	------	------	------	------	------
163	Kafir	Fall plowed	------	------	------	------	[1] 31.4	44.8	25.3	25.2
168	do	Spring plowed	------	------	------	------	[1] 22.4	25.7	29.3	22.9
169	do	do	------	------	------	------	[1] 35.3	31.4	31.4	17.8
294	do	do	------	------	------	------	[1] 6.4	37.9	37.1	21.6
161	Cowpeas	Fall plowed	------	------	------	------	[1] 17.2	45.2	34.3	31.7
162	do	Spring plowed	------	------	------	------	[1] 11.2	23.2	24.0	20.3
295	do	do	------	------	------	------	[1] 11.4	40.3	39.7	26.4
166	Winter rye	do	------	------	------	------	[1] 7.8	43.9	42.6	27.6
292	Corn	do	------	------	------	------	[1] 11.4	37.2	34.0	22.1
293	Peanuts	do	------	------	------	------	[1] 10.5	36.6	29.5	26.9
300	Beans	do	------	------	------	------	[1] 10.7	29.5	23.3	28.4
303	Sorgo	do	------	------	------	------	------	------	------	------
C-D	Fallow	Fallowed	[1] 50.3	54.8	22.6	13.1	23.1	45.4	33.9	34.7
MF-H-I	do	do	[1] 30.7	35.5	20.2	14.0	16.9	42.2	10.0	32.8
MF-J-K	do	do	[1] 26.2	35.3	22.1	14.7	17.6	37.8	11.2	34.1
MF-L-M	do	do	[1] 27.8	34.7	21.7	13.8	14.3	34.0	10.7	32.4
MF-N-O	do	do	[1] 27.4	33.3	24.8	19.7	15.2	27.6	14.5	28.3
165	do	do	------	------	------	------	[1] 16.2	20.1	16.7	21.4

[1] Not included in average.

TABLE 25.—*Yields of milo grown under different methods of cultivation and crop sequence on the north field, 1914–38*—Continued

Plot or rotation	Preceding crop	Tillage method	Acre yield								
			1922	1923	1924	1925	1926	1927	1928	1929	1930
			Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Milo	Spring plowed	16.4	23.8	15.0	25.9	23.4	20.7	27.6	31.4	26.0
B	do	Fall plowed	14.8	23.8	26.7	28.6	25.0	25.9	39.8	41.4	30.7
E	do	Subsoiled	5.9	26.4	22.8	27.9	27.2	29.0	40.7	39.0	34.0
F	do	Listed	12.4	10.5	10.3	11.7	15.3	0	19.8	12.4	16.6
G	do	Disked and listed	15.0	15.9	15.2	12.9	17.2	0	19.1	12.4	17.4
A′	do	Spring plowed				27.6	21.6	16.9	24.7	27.1	25.2
H′	do	Spring plowed and manured.				26.2	16.6	18.1	37.2	40.2	36.6
163	Kafir	Fall plowed	21.7	21.9	21.0	22.4	26.2	23.8	42.8	39.0	36.9
168	do	Spring plowed	18.2	26.0	14.8	14.7	23.3	15.3	20.7	26.7	27.6
169	do	do	26.2	27.9	12.9	22.8	22.4	24.5	28.1	30.7	33.6
294	do	do	21.0	25.9	18.3	20.9	24.3	21.9	28.8	26.9	31.2
161	Cowpeas	Fall plowed	21.9	25.0	29.1	32.1	32.1	36.7	45.7	50.0	46.7
162	do	Spring plowed	20.2	18.8	14.1	22.2	20.5	5.2	28.6	28.8	28.1
295	do	do	26.7	31.9	27.4	21.4	30.7	28.4	34.5	37.4	35.7
166	Winter rye	do	20.2	21.2	40.0	36.2	37.1	33.3	47.4	34.8	43.6
292	Corn	do	28.3	26.9	19.7	20.5	26.7	20.0	29.7	34.1	29.3
293	Peanuts	do	26.7	28.1	21.7	20.3	30.3	24.8	26.7	40.3	35.3
300	Beans	do	29.8	25.0	22.4	18.4	26.9	17.2	27.8	32.1	35.0
303	Sorgo	do				12.4	15.3	19.5	19.7	25.7	24.3
C–D	Fallow	Fallowed	25.3	36.4	36.2	40.3	35.2	44.5	46.4	52.1	51.9
MF-H-I	do	do	13.4	26.9	13.3	(2)					
MF-J-K	do	do	10.0	29.7	12.1	(2)					
MF-L-M	do	do	13.1	26.0	13.4	(2)					
MF-N-O	do	do	16.7	21.0	14.5	(2)					
165	do	do	16.3	17.9	18.6	16.2	23.3	15.5	29.0	29.5	31.4

Plot or rotation	Preceding crop	Tillage method	Acre yield								
			1931	1932	1933	1934	1935	1936	1937	1938	Average
			Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Milo	Spring plowed	30.3	9.7	0	0.5	2.8	0.9	25.3	7.1	18.6
B	do	Fall plowed	27.2	6.7	0	.3	2.9	0	7.8	3.2	19.1
E	do	Subsoiled	30.3	13.1	0	.5	1.7	0	2.8	3.0	19.8
F	do	Listed	16.2	14.1	0	2.2	6.7	.9	9.3	3.8	12.0
G	do	Disked and listed	20.5	9.1	0	2.4	8.6	5.3	12.1	6.8	12.7
A′	do	Spring plowed	20.7	7.1	0	8.6	24.7	16.2	29.8	6.5	18.3
H′	do	Spring plowed and manured.	34.0	16.4	0	5.0	19.8	9.5	23.4	4.5	20.5
163	Kafir	Fall plowed	35.5	17.8	0	1.2	7.9	.3	6.4	3.8	21.2
168	do	Spring plowed	24.7	10.0	0	8.8	16.2	10.0	28.3	11.2	18.7
169	do	do	35.5	11.2	0	3.4	14.0	.9	26.9	7.5	20.5
294	do	do	27.6	15.9	0	.2	2.6	0	20.9	4.7	19.4
161	Cowpeas	Fall plowed	36.7	13.4	0	.3	10.9	1.7	11.7	6.6	25.6
162	do	Spring plowed	31.7	11.0	0	4.0	23.6	8.4	21.9	9.6	18.2
295	do	do	32.2	17.6	0	.7	10.5	.5	21.6	9.9	23.7
166	Winter rye	do	39.7	16.7	0	.5	1.4	0	12.1	11.5	25.5
292	Corn	do	26.6	16.0	0	.7	4.0	0	25.5	8.2	20.5
293	Peanuts	do	34.5	14.5	0	3.1	11.7	1.0	20.5	12.9	22.3
300	Beans	do	31.0	15.9	0	2.6	18.8	4.1	24.7	11.0	21.2
303	Sorgo	do	23.4	11.6	0	3.6	14.5	.7	22.1	5.9	14.2
C–D	Fallow	Fallowed	44.3	29.0	0	.2	25.5	4.8	9.5	10.6	30.0
MF-H-I	do	do									[3] 22.5
MF-J-K	do	do									[3] 22.5
MF-L-M	do	do									[3] 21.4
MF-N-O	do	do									[3] 21.6
165	do	do	33.4	6.7	0	7.2	25.7	12.8	17.4	8.3	18.4

[2] Transferred to west field in 1925.

[3] Average for 1915–24.

TABLE 26.—*Yields of milo grown under different methods of cultivation and crop sequence in the west field in one or more years, 1924–38*

Plot or rotation	Preceding crop	Tillage method	Acre yield															Average
			1924	1925	1926	1927	1928	1929	1930	1931	1932	1933	1934	1935	1936	1937	1938	
			Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
LM-1	Milo	Disked		(1)	25.2	18.4	29.0	25.2	31.9	18.3	4.3	0	1.6	5.5	0	4.0	2.2	12.7
LM-2	do	do		(1)	27.8	20.9	30.0	29.3	28.6	22.1	5.7	0	2.4	2.8	0	6.9	2.6	13.8
LM-3	do	Listed		(1)	20.2	19.7	33.8	22.8	12.9	7.4	5.3	0	5.3	4.0	.2	17.4	3.0	11.7
LM-4	do	do		(1)	17.2	0	32.6	29.1	21.6	15.3	7.6	0	5.2	2.9	0	13.4	1.7	11.3
LM-5	do	do		(1)	22.9	0	30.7	20.2	13.4	12.4	5.0	0	5.3	2.6	.2	5.7	2.9	9.3
LM-6	do	do		(1)	19.3	0	25.3	16.9	12.2	15.9	5.2	0	2.2	3.4	0	4.8	.6	8.1
LM-7	do	do		(1)	20.7	0	30.0	24.7	16.0	13.1	4.0	0	2.8	2.6	.2	8.3	3.7	9.7
MF-H-I	Fallow	Fallowed	37.6	49.1	37.4	47.4	51.6	63.1	55.9	49.5	39.3	0	0	29.0	0	16.2	10.4	32.4
MF-J-K	do	do	43.8	50.9	38.4	53.8	56.9	59.3	50.0	46.0	37.6	0	0	38.6	0	21.4	8.9	33.7
MF-L-M	do	do	40.5	49.7	32.6	49.3	58.4	61.6	55.7	49.3	39.8	0	0	25.3	0	7.4	10.0	32.0
MF-N-O	do	do	36.9	55.2	32.2	46.0	56.7	64.3	50.0	42.6	26.7	0	0	7.2	0	3.1	7.1	28.5
MF-P-Q	do	do		(1)	40.3	58.3	45.2	59.7	55.5	44.5	35.5	0	4.0	24.3	0	20.5	9.9	30.6
298	do	do		(1)	23.3	46.2	60.5	61.6	54.8	49.8	34.5	0	0	6.2	0	1.9	8.8	26.7
302	do	do		(1)	29.7	47.9	61.2	54.8	60.5	39.7	37.4	0	0	7.9	0	2.6	9.1	27.0
296	Cowpeas	Green manure		(1)	26.4	32.4	55.3	58.1	44.7	32.4	23.6	0	0	3.4	0	1.0	6.8	21.9
299	Sudan grass	do		(1)	22.8	21.2	52.1	43.4	40.9	38.6	12.8	0	0	4.5	0	1.2	3.4	18.5
301	Cowpeas	Spring plowed		(1)	29.1	29.3	40.7	40.2	39.5	26.9	21.6	0	0	2.6	0	5.3	4.7	18.5
295-W	do	do						[2]42.9	49.1	35.9	30.7	0	0	10.5	2.2	10.5	14.2	17.0
336	Soybeans	do						[2]60.9	40.2	25.9	21.7	0	0	6.9	2.6	8.8	5.1	12.4
340	Cowpeas, milo	do						[2]62.6	48.1	42.2	28.8	0	.3	5.0	0	9.3	8.0	15.7
341	Cowpeas, kafir	do						[2]64.3	38.6	33.6	23.6	0	0	5.0	0	7.1	3.5	12.4
342	Cowpeas, Sudan grass.	do						[2]65.0	29.8	30.3	13.3	0	0	7.4	0	7.2	3.3	10.1
239	Sweetclover	do							[2]44.1	40.3	21.7	0	0	13.3	0	2.9	1.6	10.0
293-W	Peanuts	do						[2]56.9	46.7	32.1	29.0	0	0	6.9	.7	8.8	11.9	15.1

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[1] First year's yields not recorded separately and not included in the averages.
[2] Not included in average.

TABLE 27.—*Yields of kafir grain and kafir total weight under different methods of cultivation and crop sequence in the north field, 1914–38*

Crop and plot or rotation	Preceding crop	Tillage method	Acre yield							
			1914 [1]	1915	1916	1917	1918	1919	1920	1921
Kafir, grain:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Kafir	Spring plowed	31. 2	45. 8	5. 0	0	14. 7	28. 5	26. 7	22. 7
B	do	Fall plowed	35. 0	40. 2	8. 0	0	9. 0	41. 8	26. 8	28. 8
E	do	Subsoiled	36. 7	39. 7	9. 2	0	14. 0	42. 0	23. 2	19. 7
F	do	Listed	32. 2	33. 8	16. 7	4. 3	16. 8	26. 7	16. 0	17. 3
G	do	Disked and listed.	37. 3	27. 2	11. 0	0	11. 2	38. 3	17. 5	19. 7
160	do	Spring plowed					[1] 5. 0	36. 7	30. 8	22. 3
161	Milo	Fall plowed					[1] 11. 8	35. 5	23. 2	30. 5
162	do	Spring plowed					[1] 6. 2	15. 0	16. 8	17. 7
165	do	do					[1] 9. 0	21. 8	6. 3	20. 0
294	do	do					[1] 5. 3	26. 0	22. 7	27. 7
160	Cowpeas	do					[1] 10. 8	43. 5	34. 5	25. 5
163	do	Fall plowed					[1] 12. 7	38. 9	26. 2	26. 3
169	do	Spring plowed					[1] 22. 2	30. 0	27. 7	17. 5
82	Winter rye	Green manure	26. 2	40. 0	13. 5	4. 3	6. 3	12. 3	21. 8	37. 0
83a	Sudan grass	do	28. 3	55. 8	15. 8	10. 0	12. 3	14. 5	23. 5	20. 8
167	Winter rye	Spring plowed					[1] 5. 2	33. 2	28. 0	34. 3
83b	Sudan grass	do								
C–D	Fallow	Fallowed	34. 2	48. 0	23. 7	6. 0	14. 5	43. 3	21. 9	31. 3
H–I	do	do					[1] 8. 0	17. 6	11. 5	21. 7
J–K	do	do					[1] 9. 2	18. 7	16. 7	20. 4
L–M	do	do					[1] 10. 0	22. 3	21. 5	23. 0
N–O	do	do					[1] 11. 5	26. 0	20. 5	31. 7
P–Q	do	do					[1] 9. 7	24. 2	17. 5	31. 5
168	do	do					[1] 15. 0	24. 3	22. 8	18. 2
Kafir, total weight:			*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
A	Kafir	Spring plowed	7, 800	8, 350	3, 500	1, 600	3, 720	5, 080	6, 730	4, 625
B	do	Fall plowed	8, 750	7, 850	3, 100	1, 550	3, 000	6, 960	6, 550	4, 500
E	do	Subsoiled	9, 150	8, 500	3, 750	1. 450	3, 060	7, 250	5, 500	3, 810
F	do	Listed	8, 050	6, 750	4, 500	1,,700	3, 310	4, 520	5, 300	3, 875
G	do	Disked and listed.	9, 350	7, 450	3, 400	2, 200	2, 340	4, 300	5, 900	4, 300
160	Kafir	Spring plowed					[1] 3, 400	6, 010	6, 150	4, 440
161	Milo	Fall plowed					[1] 3, 800	6, 730	5, 250	6, 250
162	do	Spring plowed					[1] 2, 850	3, 530	5, 250	4, 690
165	do	do					[1] 4, 450	3, 580	3, 900	5, 940
294	do	do					[1] 1, 900	4, 550	5, 240	5, 125
160	Cowpeas	do					[1] 4, 200	7, 710	7, 500	5, 190
163	do	Fall plowed					[1] 4, 200	6, 645	6, 600	5, 310
169	do	Spring plowed					[1] 5, 810	4, 700	7, 400	3, 830
82	Winter rye	Green manure	7, 050	6, 800	5, 500	2, 800	2, 200	3, 200	5, 600	7, 200
83a	Sudan grass	do	7, 500	8, 250	5, 100	3, 400	4, 500	2, 900	5, 250	6, 310
167	Winter rye	Spring plowed					[1] 2, 500	5, 490	7, 230	7, 000
83b	Sudan grass	do								
C–D	Fallow	Fallowed	8, 550	10, 550	5, 400	2, 300	3, 470	7, 340	6, 540	7, 060
H–I	do	do					[1] 2, 800	3, 560	4, 350	6, 200
J–K	do	do					[1] 3, 050	3, 740	4, 550	6, 560
L–M	do	do					[1] 2, 700	3, 700	5, 300	6, 750
N–O	do	do					[1] 2, 900	4, 320	4, 750	6, 690
P–Q	do	do					[1] 2, 650	4, 310	4, 350	6, 690
168	do	do					[1] 5, 090	4, 345	5, 750	5, 810

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[1] Not included in average.

TABLE 27.—*Yields of kafir grain and kafir total weight under different methods of cultivation and crop sequence in the north field, 1914–38*—Continued

Crop and plot or rotation	Preceding crop	Tillage method	Acre yield								
			1922	1923	1924	1925	1926	1927	1928	1929	1930
Kafir, grain:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Kafir	Spring plowed	8.2	24.5	25.3	30.3	25.7	14.3	24.2	25.3	27.0
B	do	Fall plowed	3.2	28.5	29.2	20.8	21.2	24.2	33.8	32.2	36.3
E	do	Subsoiled	3.2	29.5	34.3	26.7	25.3	24.3	35.7	33.0	36.2
F	do	Listed	18.5	18.3	11.7	20.0	21.8	0	19.3	11.5	17.8
G	do	Disked and listed.	24.0	20.8	24.2	22.5	24.8	0	18.3	19.7	17.7
160	do	Spring plowed	21.2	34.7	31.8	35.7	27.3	24.0	30.5	36.3	33.0
161	Milo	Fall plowed	3.7	25.7	27.8	30.0	25.7	22.5	29.3	32.0	35.5
162	do	Spring plowed	10.8	17.7	17.3	22.5	19.0	0	18.0	21.7	18.3
165	do	do	10.7	9.2	19.2	27.3	17.3	0	22.3	17.8	19.2
294	do	do	8.0	26.7	22.3	31.7	19.0	23.5	22.7	21.7	30.8
160	Cowpeas	do	17.0	42.8	46.3	44.2	35.8	33.2	43.8	44.2	35.7
163	do	Fall plowed	13.2	36.5	40.0	40.5	28.8	30.5	49.7	48.0	43.8
169	do	Spring plowed	19.8	36.8	36.0	40.0	30.7	22.2	36.0	37.5	35.3
82	Winter rye	Green manure	12.8	19.3	31.0	37.5	21.3	13.7	31.3	28.7	27.3
83a	Sudan grass	do	8.2	-----	-----	-----	-----	-----	-----	-----	-----
167	Winter rye	Spring plowed	12.3	25.0	45.5	40.7	36.2	30.5	44.8	34.5	44.8
83b	Sudan grass	do	-----	22.3	25.3	23.3	19.0	0	27.8	21.0	19.3
C–D	Fallow	Fallowed	18.9	39.3	39.0	49.8	34.7	32.3	38.7	45.0	36.2
H–I	do	do	16.3	19.2	32.8	34.5	23.7	0	27.3	25.3	28.2
J–K	do	do	15.5	18.7	30.7	30.5	30.5	0	32.8	22.2	31.0
L–M	do	do	21.2	16.7	34.0	33.3	31.5	0	33.5	21.0	35.0
N–O	do	do	22.3	28.0	35.7	38.8	30.8	0	36.8	26.3	34.3
P–Q	do	do	16.3	24.7	20.2	27.0	23.5	0	31.8	14.8	18.0
168	do	do	17.8	29.7	25.3	43.2	29.0	6.3	34.7	29.0	15.8
Kafir, total weight:			*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
A	Kafir	Spring plowed	2,900	6,100	4,700	6,700	5,050	3,250	4,000	5,050	3,800
B	do	Fall plowed	2,650	7,900	4,700	6,300	5,350	5,150	4,150	6,500	5,100
E	do	Subsoiled	3,055	7,200	5,100	5,850	6,150	4,800	4,650	6,550	5,100
F	do	Listed	4,150	4,200	4,600	5,300	4,450	2,150	3,750	2,450	3,150
G	do	Disked and listed.	4,000	4,700	5,050	5,850	4,900	2,750	3,550	4,550	3,400
160	do	Spring plowed	5,100	9,200	5,100	8,400	6,350	5,350	4,750	6,200	4,950
161	Milo	Fall plowed	3,100	6,550	5,300	7,200	6,100	4,800	4,900	5,450	5,200
162	do	Spring plowed	3,900	4,750	4,750	6,500	5,400	2,650	6,500	4,500	3,850
165	do	do	4,170	6,700	5,050	6,850	6,100	3,250	4,700	4,350	3,750
294	do	do	2,950	6,300	4,200	7,250	4,800	4,750	3,300	5,050	4,300
160	Cowpeas	do	5,600	10,750	6,750	11,150	8,150	7,250	6,050	7,200	5,100
163	do	Fall plowed	4,400	8,700	6,800	10,200	8,300	7,250	7,350	7,850	6,050
169	do	Spring plowed	5,100	8,550	7,500	10,500	8,300	6,250	5,800	7,000	4,950
82	Winter rye	Green manure	4,500	6,900	6,700	10,100	7,700	5,800	6,750	6,200	4,900
83a	Sudan grass	do	3,250	-----	-----	-----	-----	-----	-----	-----	-----
167	Winter rye	Spring plowed	3,450	7,700	7,050	9,700	8,150	7,100	6,900	5,900	6,150
83b	Sudan grass	do	-----	5,300	5,250	6,000	5,700	3,900	4,900	4,650	3,850
C–D	Fallow	Fallowed	4,940	10,450	6,650	13,050	7,800	7,800	6,600	8,300	5,450
H–I	do	do	5,450	7,450	6,750	10,050	6,400	4,750	5,450	5,800	5,600
J–K	do	do	5,400	7,100	7,100	9,900	7,300	4,000	5,900	5,450	5,550
L–M	do	do	5,650	9,150	6,500	9,550	7,500	4,000	5,800	5,650	5,350
N–O	do	do	5,550	7,800	6,650	9,050	6,650	4,650	6,350	6,500	5,400
P–Q	do	do	5,100	7,650	6,300	8,200	7,400	3,050	6,500	4,850	4,400
168	do	do	5,830	8,200	6,050	11,750	8,050	3,700	5,450	7,450	3,150

TABLE 27.—*Yields of kafir grain and kafir total weight under different methods of cultivation and crop sequence in the north field, 1914–38*—Continued

Crop and plot or rotation	Preceding crop	Tillage method	Acre yield								
			1931	1932	1933	1934	1935	1936	1937	1938	Average
Kafir, grain:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Kafir	Spring plowed	25.3	15.5	0	3.3	21.7	5.0	18.8	8.6	18.6
B	do	Fall plowed	31.3	20.0	0	1.8	8.2	0	3.8	6.2	19.0
E	do	Subsoiled	31.7	20.8	0	.8	6.7	0	2.5	4.2	19.3
F	do	Listed	25.3	9.8	0	7.0	19.8	0	7.3	3.1	14.3
G	do	Disked and listed.	26.8	7.5	0	4.8	16.8	0	5.8	3.5	15.1
160	do	Spring plowed	32.8	26.3	0	1.2	11.2	0	32.7	5.7	23.7
161	Milo	Fall plowed	31.3	14.2	0	2.8	5.0	0	3.7	9.1	19.4
162	do	Spring plowed	22.2	9.5	0	6.3	10.5	2.3	17.3	8.8	13.6
165	do	do	25.0	2.2	0	7.8	11.2	4.0	16.3	7.7	13.3
294	do	do	25.0	18.7	0	.7	3.0	0	5.7	2.7	16.9
160	Cowpeas	do	41.7	27.5	0	.3	21.2	0	23.3	14.7	28.8
163	do	Fall plowed	38.2	24.7	0	.5	11.8	.5	16.5	5.3	26.0
169	do	Spring plowed	39.2	20.8	0	3.0	26.5	5.3	29.2	14.6	25.4
82	Winter rye	Green manure	31.2	19.3	0	3.0	20.7	8.5	13.0	9.2	19.3
83a	Sudan grass	do	----	----	----	----	----	----	----	----	20.1
167	Winter rye	Spring plowed	35.5	25.7	0	1.7	12.2	0	16.0	6.4	25.4
83b	Sudan grass	do	23.8	8.3	0	3.5	18.0	1.2	20.2	10.7	15.2
C–D	Fallow	Fallowed	44.3	27.2	0	2.3	36.3	13.0	10.5	14.1	27.9
H–I	do	do	29.0	16.7	0	2.0	23.2	2.0	21.7	8.2	18.0
J–K	do	do	29.7	19.8	0	2.2	28.3	2.0	20.3	7.2	18.9
L–M	do	do	28.8	22.7	0	2.3	21.3	2.2	13.5	7.4	19.6
N–O	do	do	32.5	19.8	0	3.3	20.7	2.7	6.5	9.5	21.3
P–Q	do	do	23.0	6.3	0	3.0	10.5	3.3	13.0	5.3	15.7
168	do	do	37.8	7.0	0	6.2	17.5	13.8	16.0	8.2	20.1
Kafir, total weight:			*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
A	Kafir	Spring plowed	3,700	2,750	0	1,400	4,600	2,600	3,900	2,450	4,023
B	do	Fall plowed	4,440	3,300	0	1,000	2,950	1,350	2,000	2,300	4,110
E	do	Subsoiled	4,550	3,200	0	600	2,750	1,550	1,950	2,500	4,120
F	do	Listed	4,050	2,450	0	2,100	4,100	600	2,300	1,600	3,390
G	do	Disked and listed.	4,000	2,000	0	1,900	4,100	800	2,350	1,750	3,564
160	do	Spring plowed	4,450	3,500	0	2,200	3,900	1,850	6,000	2,750	4,833
161	Milo	Fall plowed	4,600	2,650	0	1,300	3,100	1,250	2,300	2,700	4,237
162	do	Spring plowed	3,600	2,750	0	2,000	3,200	1,700	3,450	2,200	3,759
165	do	do	3,720	2,400	0	2,100	3,100	2,050	3,600	2,050	3,868
294	do	do	3,600	2,950	0	800	2,750	1,200	2,700	2,150	3,698
160	Cowpeas	do	5,300	3,950	0	1,400	6,800	2,900	5,450	4,750	5,948
163	do	Fall plowed	5,000	3,700	0	1,100	4,950	1,900	4,100	2,350	5,428
169	do	Spring plowed	5,050	3,600	0	1,300	6,650	3,650	5,650	3,650	5,472
82	Winter rye	Green manure	5,560	4,150	0	1,300	5,300	4,700	3,150	3,000	5,000
83a	Sudan grass	do	----	----	----	----	----	----	----	----	4,870
167	Winter rye	Spring plowed	4,900	3,750	0	800	3,650	900	3,850	2,550	5,111
83b	Sudan grass	do	3,750	2,750	0	1,600	4,450	1,400	3,850	2,900	3,766
C–D	Fallow	Fallowed	5,890	4,400	0	2,200	6,850	5,650	3,600	3,950	6,093
H–I	do	do	5,350	4,800	0	1,400	7,700	3,250	4,450	3,100	5,093
J–K	do	do	5,350	4,900	0	1,100	7,250	3,150	4,550	2,200	5,053
L–M	do	do	5,100	4,600	0	1,400	6,450	3,200	3,850	3,000	5,125
N–O	do	do	5,700	4,500	0	1,900	6,100	3,300	2,800	2,650	5,066
P–Q	do	do	4,850	3,500	0	1,900	5,650	3,400	2,650	2,100	4,693
168	do	do	6,280	3,500	0	2,300	6,700	4,150	3,750	2,900	5,256

Table 28.—*Yields of cowpea hay grown under different methods of cultivation and crop sequence in the north and west fields, 1914–38*

Field and rotation or plot	Preceding crop	Tillage method	Acre yield								
			1914 [1]	1915	1916	1917	1918	1919	1920	1921	1922
North:			*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
82	Kafir	Spring plowed	1,960	0	320	1,150	1,200	950	1,750	1,600	950
83	do	do	2,520	0	280	1,850	1,400	850	1,700	1,700	1,300
160	do	do	-----	-----	-----	-----	[1] 1,400	2,000	2,300	2,200	1,500
161	do	Fall plowed	-----	-----	-----	-----	[1] 1,850	1,250	1,900	2,000	850
162	do	Spring plowed	-----	-----	-----	-----	[1] 1,300	1,000	1,100	1,650	1,200
167	do	do	-----	-----	-----	-----	[1] 1,420	1,800	2,100	2,200	1,350
163	Milo	Fall plowed	-----	-----	-----	-----	[1] 0	1,830	1,800	2,000	1,200
166	do	Spring plowed	-----	-----	-----	-----	[1] -,200	2,000	2,150	2,300	1,300
169	do	do	-----	-----	-----	-----	[1] 1,950	1,070	2,100	1,500	1,300
295	do	do	-----	-----	-----	-----	[1] 0	1,060	2,050	2,300	1,300
59	Winter rye	Fall plowed	1,300	0	250	900	800	1,000	1,600	1,800	650
West:											
59	do	do	-----	-----	-----	-----	-----	-----	-----	-----	-----
84	Sudan grass	Spring plowed	[1] 0	0	830	650	610	1,420	2,450	2,000	1,200
87	do	do	[1] 0	0	220	710	540	1,150	2,350	1,050	1,100
88	Corn	do	-----	0	560	840	590	1,770	1,900	2,200	1,100
89	do	do	[1] 0	0	410	700	510	-----	1,950	2,750	1,100
295-W	Milo	do	-----	-----	-----	-----	-----	-----	-----	-----	-----
301	do	do	-----	-----	-----	-----	-----	-----	-----	-----	-----
337	Fallow	Fallowed	-----	-----	-----	-----	-----	-----	-----	-----	-----

Field and rotation or plot	Preceding crop	Tillage method	Acre yield							
			1923	1924	1925	1926	1927	1928	1929	1930
North:			*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
82	Kafir	Spring plowed	1,150	1,350	1,950	1,750	1,200	1,650	2,050	1,250
83	do	do	1,400	1,650	2,300	1,300	1,000	1,200	2,300	1,550
160	do	do	750	2,500	2,450	2,300	1,900	2,250	4,700	2,600
161	do	Fall plowed	900	1,400	2,150	1,800	1,400	2,350	3,200	2,400
162	do	Spring plowed	950	1,100	1,800	1,050	1,200	1,250	2,150	1,600
167	do	do	1,350	2,600	2,050	2,150	1,900	2,100	3,800	2,400
163	Milo	Fall plowed	660	1,700	2,750	1,800	1,800	2,350	3,900	2,450
166	do	Spring plowed	1,055	2,100	2,100	2,000	1,550	1,950	3,950	1,800
169	do	do	750	2,000	2,900	1,900	1,800	1,900	3,550	2,200
295	do	do	1,950	1,250	2,300	1,400	1,150	1,750	2,550	1,600
59	Winter rye	Fall plowed	1,500	2,150	-----	-----	-----	-----	-----	-----
West:										
59	do	do	[1] 1,400	2,200	3,150	1,700	2,100	2,600	3,400	2,600
84	Sudan grass	Spring plowed	950	1,400	1,950	1,650	1,900	2,050	3,450	1,900
87	do	do	1,600	1,100	2,250	1,300	1,650	1,850	2,950	1,850
88	Corn	do	1,500	1,600	1,600	1,400	1,900	1,450	3,000	2,000
89	do	do	1,150	1,750	1,300	1,300	2,100	1,750	3,100	1,850
295-W	Milo	do	-----	-----	-----	-----	-----	-----	[1] 4,150	2,900
301	do	do	-----	-----	-----	2,400	1,900	1,900	3,000	2,450
337	Fallow	Fallowed	-----	-----	-----	-----	-----	-----	[1] 4,200	3,250

Field and rotation or plot	Preceding crop	Tillage method	Acre yield								
			1931	1932	1933	1934	1935	1936	1937	1938	Average
North:			*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*	*Lb.*
82	Kafir	Spring plowed	1,900	1,250	0	0	1,200	800	1,100	950	1,145
83	do	do	1,350	1,550	0	400	1,750	750	1,150	1,350	1,253
160	do	do	3,000	2,100	0	1,000	2,580	750	1,450	1,600	1,997
161	do	Fall plowed	2,400	1,150	0	200	1,500	500	650	1,000	1,450
162	do	Spring plowed	1,300	1,000	0	600	1,650	630	1,000	950	1,159
167	do	do	2,850	1,700	0	0	2,400	900	1,250	600	1,775
163	Milo	Fall plowed	2,400	1,300	0	300	2,750	630	900	1,300	1,691
166	do	Spring plowed	2,650	1,800	0	0	1,500	600	900	700	1,620
169	do	do	2,300	1,800	0	900	3,000	550	1,550	850	1,696
295	do	do	1,850	1,450	0	400	1,150	750	850	1,400	1,426
59	Winter rye	Fall plowed	-----	-----	-----	-----	-----	-----	-----	-----	1,065
West:											
59	do	do	3,110	1,500	0	0	1,450	1,150	1,650	900	1,834
84	Sudan grass	Spring plowed	2,500	2,050	0	0	2,400	500	1,000	850	1,405
87	do	do	2,550	1,800	0	0	1,700	500	1,125	950	1,262
88	Corn	do	2,400	1,500	0	0	2,500	700	1,000	900	1,350
89	do	do	2,800	1,450	0	0	2,000	550	810	850	1,312
295-W	Milo	do	2,550	1,550	0	0	1,500	450	1,200	1,250	1,267
301	do	do	2,900	1,100	0	0	1,150	500	750	1,000	1,465
337	Fallow	Fallowed	3,500	2,300	0	600	3,750	1,330	1,850	1,600	2,020

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[1] Not included in the average.

TABLE 29.—*Yields of winter rye grown under different methods of cultivation and crop sequence in the north and west fields, 1914–38*

Field and rotation or plot	Preceding crop	Tillage method	Acre yield								
			1914	1915	1916	1917	1918	1919	1920	1921	1922
			Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
North:											
A	Winter rye	Late fall plowed	------	------	------	------	------	(1)	5.5	9.6	0
B	do	Early fall plowed	------	------	------	------	------	(1)	16.1	29.8	0
58	Oats	Fall plowed	------	------	------	------	------	------	16.1	6.1	0
59	do	do	------	------	------	------	------	------	17.0	14.5	0
166	Cowpeas	Disked	------	------	------	------	(1)	28.9	21.1	14.6	0
167	do	do	------	------	------	------	(1)	27.7	23.8	13.4	0
C–D	Fallow	Fallowed	------	------	------	------	------	(1)	27.5	18.9	0
West:											
58	Oats	Fall plowed	------	------	------	------	------	------	------	------	------
59	do	do	------	------	------	------	------	------	------	------	------
84	Cowpeas	do	[2] 0	9.0	7.9	0	0	0	24.5	31.8	0
87	do	do	[2] 0	7.5	7.7	0	0	0	22.9	25.5	0
88	do	do	[2] 0	12.4	10.4	0	0	0	26.1	32.9	0
89	do	do	------	------	------	------	------	------	[2] 24.6	32.0	0

Field and rotation or plot	Preceding crop	Tillage method	Acre yield								
			1923	1924	1925	1926	1927	1928	1929	1930	1931
			Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
North:											
A	Winter rye	Late fall plowed	0	4.8	0	13.8	0	2.5	2.9	0.9	2.5
B	do	Early fall plowed	0	7.9	0	19.3	0	13.8	17.3	12.0	7.7
58	Oats	Fall plowed	0	0	------	------	------	------	------	------	------
59	do	do	0	10.4	------	------	------	------	------	------	------
166	Cowpeas	Disked	0	8.0	0	14.3	0	3.9	9.3	8.6	6.4
167	do	do	0	8.2	0	12.9	0	3.4	8.0	6.4	6.6
C–D	Fallow	Fallowed	0	13.0	0	24.5	0	12.1	20.5	17.0	18.9
West:											
58	Oats	Fall plowed	------	0	0	13.9	0	4.1	10.7	12.0	18.4
59	do	do	------	0	0	14.3	0	5.5	13.9	15.2	20.0
84	Cowpeas	do	0	10.5	0	22.3	0	3.2	21.6	17.9	13.2
87	do	do	0	9.8	0	22.1	0	7.1	18.2	12.3	14.3
88	do	do	0	10.2	0	19.5	0	7.0	19.8	6.8	18.0
89	do	do	0	13.2	0	28.0	0	8.6	18.9	8.6	20.7

Field and rotation or plot	Preceding crop	Tillage method	Acre yield							
			1932	1933	1934	1935	1936	1937	1938	Average
			Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
North:										
A	Winter rye	Late fall plowed	2.7	0	0	0	0	0	0	2.4
B	do	Early fall plowed	8.6	3.0	0	0	0	0	0	7.1
58	Oats	Fall plowed	------	------	------	------	------	------	------	4.4
59	do	do	------	------	------	------	------	------	------	8.4
166	Cowpeas	Disked	8.6	0	0	0	0	0	0	6.2
167	do	do	10.2	0	0	0	0	0	0	6.0
C–D	Fallow	Fallowed	14.8	3.9	0	0	0	0	0	9.0
West:										
58	Oats	Fall plowed	11.8	0	0	0	0	0	0	4.7
59	do	do	5.7	0	0	0	0	0	0	5.0
84	Cowpeas	do	4.5	0	0	0	0	0	0	6.9
87	do	do	2.5	0	0	0	0	0	0	6.2
88	do	do	8.2	0	0	0	0	0	0	7.1
89	do	do	15.4	0	0	0	0	0	0	8.1

[1] First year's yields not recorded separately and not included in the averages.

[2] Not included in average.

Table 30.—*Yields of winter wheat in the west field, 1926–38*

Rotation No.	Preceding crop	Tillage method	Acre yield						
			1926	1927	1928	1929	1930	1931	1932
			Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
1	Winter wheat	Late fall plowed	[1]45. 6	0	4. 5	13. 3	4. 2	23. 8	0. 2
2	do	Early fall plowed	45. 6	0	9. 7	24. 3	15. 7	27. 8	2. 3
3	do	Disked	45. 6	0	8. 7	14. 7	10. 0	22. 3	3. 0
4	do	Listed	45. 6	0	6. 7	18. 7	9. 5	23. 3	4. 8
5 or 6	Fallow	Fallowed	45. 6	2. 1	7. 5	29. 8	20. 7	40. 3	30. 3

Rotation No.	Preceding crop	Tillage method	Acre yield						
			1933	1934	1935	1936	1937	1938	Average, 1927–38
			Bu.	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
1	Winter wheat	Late fall plowed	0	0	0	0	0	0	3. 8
2	do	Early fall plowed	0	0	0	0	0	0	6. 7
3	do	Disked	0	0	0	0	0	0	4. 9
4	do	Listed	0	0	0	0	0	0	5. 3
5 or 6	Fallow	Fallowed	3. 5	0	0	0	0	0	11. 2

[1] Plots all on fallow, not harvested separately and not included in the average.

Table 31.—*Yields of corn in the north and west fields, 1914–38*

Field and plot or rotation	Preceding crop	Tillage method	Acre yield								
			1914	1915	1916	1917	1918	1919	1920	1921	1922
North:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Corn	Spring plowed	(1)	39. 9	2. 8	0	0	0	20. 7	25. 7	8. 7
B	do	Fall plowed	(1)	42. 6	1. 5	0	0	0	14. 0	27. 1	2. 4
E	do	Fall plowed and subsoiled.	(1)	38. 9	1. 8	0	0	8. 4	18. 5	27. 6	0
F	do	Listed	(1)	33. 5	6. 7	0	0	6. 0	15. 5	16. 4	8. 3
G	do	Disked and listed	(1)	32. 1	3. 5	0	0	6. 4	14. 7	17. 9	12. 0
292	Milo	Spring plowed	------	------	------	------	[1]0	25. 9	0	32. 1	0
C-D	Fallow	Fallowed	(1)	56. 1	13. 2	1. 7	0	12. 7	21. 8	35. 0	9. 0
West:											
88	Winter rye	Spring plowed	------	------	(1)	0	0	24. 4	23. 3	18. 7	11. 7
89	do	Spring plowed and manured.	------	------	(1)	0	0	------	19. 3	13. 4	11. 1

Field and plot or rotation	Preceding crop	Tillage method	Acre yield								
			1923	1924	1925	1926	1927	1928	1929	1930	1931
North:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Corn	Spring plowed	25. 5	22. 9	25. 7	17. 6	16. 9	24. 1	20. 3	19. 4	17. 0
B	do	Fall plowed	26. 1	18. 6	22. 3	12. 5	13. 3	27. 7	28. 6	15. 7	15. 3
E	do	Fall plowed and subsoiled	22. 7	22. 4	22. 6	9. 3	21. 7	33. 3	25. 9	19. 6	17. 0
F	do	Listed	12. 9	16. 1	19. 1	15. 8	12. 7	16. 9	12. 4	15. 3	10. 6
G	do	Disked and listed	16. 1	16. 1	13. 9	15. 6	9. 3	16. 6.	12. 4	14. 3	9. 7
292	Milo	Spring plowed	20. 0	17. 4	24. 9	13. 6	16. 9	12. 3	15. 4	13. 0	14. 4
C-D	Fallow	Fallowed	31. 3	29. 3	45. 4	24. 3	24. 4	37. 9	37. 6	34. 0	27. 7
West:											
88	Winter rye	Spring plowed	9. 3	23. 6	26. 4	15. 6	0	24. 6	17. 7	9. 3	11. 6
89	do	Spring plowed and manured.	9. 2	27. 9	26. 1	13. 9	0	28. 4	20. 3	10. 4	9. 1

[1] Not included in average.

TABLE 31.—*Yields of corn in the north and west fields, 1914–38*—Continued

Field and plot or rotation	Preceding crop	Tillage method	Acre yield							
			1932	1933	1934	1935	1936	1937	1938	Average
North:			*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Bu.*
A	Corn	Spring plowed	3.9	0	0	0	0	7.4	0	12.4
B	do	Fall plowed	3.6	0	0	0	0	1.6	0	11.4
E	do	Fall plowed and subsoiled.	3.2	0	0	0	0	.4	0	12.2
F	do	Listed	4.3	0	0	3.4	0	3.9	.8	9.6
G	do	Disked and listed	5.1	0	0	6.6	.4	3.3	1.7	9.5
292	Milo	Spring plowed	2.5	0	0	.1	0	1.0	0	10.5
C-D	Fallow	Fallowed	7.2	0	0	2.0	.7	1.6	0	18.9
West:										
88	Winter rye	Spring plowed	6.8	0	0	0	0	.6	0	10.2
89	do	Spring plowed and manured.	9.3	0	0	0	0	.9	0	9.5

TABLE 32.—*Yields of miscellaneous crops in the north field, 1918–38*

Crop and rotation	Preceding crop	Tillage method	Acre yield							
			1918	1919	1920	1921	1922	1923	1924	1925
Grain yield:										
Peanuts:										
293 pounds	Milo	Spring plowed	[1] 400	700	0	560	460	1,090	620	330
Mexican beans:										
300 bushels	do	do	(1)	8.0	1.5	5.3	2.5	9.0	0	5.0
Sorgo, in rows:										
479 do	Sorgo	do	------	------	------	------	------	------	(1)	------
Total weight:										
Sudan grass:										
83 pounds	Cowpeas	do	------	------	------	(1)	3,250	2,200	2,600	3,600
Peanuts:										
293 do	Milo	do	[1] 1,400	4,850	0	2,200	1,750	3,100	1,190	1,500
Mexican beans:										
300 do	do	do	[1] 1,650	750	250	1,050	800	1,160	1,050	1,000
Sorgo, drilled:										
303 do	do	do	------	------	------	------	------	------	(1)	3,900
479 do	Sorgo	do	------	------	------	------	------	------	(1)	3,950
304 do	Fallow	Fallowed	------	------	------	------	------	------	(1)	4,050
Sorgo, in rows:										
479 do	Sorgo	Spring plowed	------	------	------	------	------	------	(1)	11,300

Crop and rotation	Preceding crop	Tillage method	Acre yield						
			1926	1927	1928	1929	1930	1931	1932
Grain yield:									
Peanuts:									
293 pounds	Milo	Spring plowed	350	------	600	460	500	700	320
Mexican beans:									
300 bushels	do	do	0	3.8	4.3	5.0	5.1	5.0	.3
Sorgo, in rows:									
479 do	Sorgo	do	12.0	16.4	17.9	20.2	26.6	17.3	14.5
Total weight:									
Sudan grass:									
83 pounds	Cowpeas	do	3,050	2,750	3,550	3,950	4,300	3,600	2,800
Peanuts:									
293 do	Milo	do	1,290	------	1,600	1,570	2,000	1,850	1,500
Mexican beans:									
300 do	do	do	850	850	900	1,120	620	900	300
Sorgo, drilled:									
303 do	do	do	3,300	5,000	3,800	5,700	4,700	3,050	2,550
479 do	Sorgo	do	3,550	3,800	4,250	5,350	4,100	2,950	2,400
304 do	Fallow	Fallowed	6,400	9,000	10,600	9,350	7,350	4,850	3,350
Sorgo, in rows:									
479 do	Sorgo	Spring plowed	7,000	4,500	6,800	7,200	6,450	6,600	5,000

[1] Not included in the average.

TABLE 32.—*Yields of miscellaneous crops in the north field, 1918–38*—Continued

Crop and rotation	Preceding crop	Tillage method	Acre yield						
			1933	1934	1935	1936	1937	1938	Average
Grain yield:									
Peanuts:									
293 pounds	Milo	Spring plowed	0	40	340	60	320	420	414
Mexican beans:									
300 bushels	do	do	0	1.7	1.8	0	1.0	0	3.0
Sorgo, in rows:									
479 do	Sorgo	do	0	0	19.6	2.1	13.9	1.8	11.6
Total weight:									
Sudan grass:									
83 pounds	Cowpeas	do	0	650	3,260	750	2,850	2,550	2,689
Peanuts:									
293 do	Milo	do	0	1,400	1,430	900	1,300	1,600	1,633
Mexican beans:									
300 do	do	do	0	500	590	250	450	0	670
Sorgo, drilled:									
303 do	do	do	0	900	2,200	1,400	3,450	2,000	2,996
479 do	Sorgo	do	0	1,900	5,900	1,950	4,650	2,150	3,350
304 do	Fallow	Fallowed	0	3,500	13,450	2,550	7,500	5,900	6,275
Sorgo, in rows:									
479 do	Sorgo	Spring plowed	0	500	5,700	1,750	4,400	2,750	4,996

[1] Not included in average.

TABLE 33.—*Yields of miscellaneous crops in the west field, 1908–38*

Crop and rotation or plot	Preceding crop	Tillage method	Acre yield							
			1908	1909	1910	1911	1912	1913	1914	1915
Grain yield:										
Oats:										
58[1] bushels	Sorgo	Disked	[2]0	0	0	0	0	0	15.0	1.9
59[3] do	Cowpeas	do	------	------	------	------	------	------	[2]17.3	11.9
Sorgo:										
58[1] do	Winter rye	Fall plowed	[2]0	0	0	0	16.4	0	0	31.4
Total weight:										
Sorgo:										
58[1] pounds	Winter rye	Fall plowed	[2]2,880	3,900	5,950	2,190	6,570	2,950	7,690	6,100
Sudan grass:										
84 do	Milo	Spring plowed	------	------	------	------	------	------	[2]3,600	2,750
87 do	do	Spring plowed and manured.	------	------	------	------	------	------	[2]2,750	2,190

Crop and rotation or plot	Preceding crop	Tillage method	Acre yield							
			1916	1917	1918	1919	1920	1921	1922	1923
Grain yield:										
Oats:										
58[1] bushels	Sorgo	Disked	0	0	0	5.3	0	0	0	0
59[3] do	Cowpeas	do	0	0	0	34.1	0	28.4	0	0
Sorgo:										
58[1] do	Winter rye	Fall plowed	5.4	5.4	6.4	14.8	0	18.8	9.5	5.4
Total weight:										
Sorgo:										
58[1] pounds	Winter rye	Fall plowed	3.200	2,350	1,750	5,250	5,100	4,690	2,650	2,050
Sudan grass:										
84 do	do	Spring plowed	1,210	730	510	4,050	3,440	3,690	2,950	2,800
87 do	do	Spring plowed and manured.	1,770	940	500	2,390	4,000	4,440	3,500	2,950

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[1] Rotation 58, south field 1908–14, north field 1915–24, west field 1925 to present.
[2] Not included in average.
[3] Rotation 59, north field 1914–24, west field 1925 to present.

TABLE 33.—*Yields of miscellaneous crops in the west field, 1908–38*—Continued

Crop and rotation or plot	Preceding crop	Tillage method	Acre yield							
			1924	1925	1926	1927	1928	1929	1930	1931
Grain yield:										
Oats:										
B bushels	Oats	Fall plowed	------	------	(2)	0	25.0	43.1	10.6	22.8
58 [1] do	Sorgo	Disked	0	0	9.4	0	7.5	10.0	0	1.9
59 [3] do	Cowpeas	do	10.4	0	37.5	0	21.6	41.9	.3	7.5
C–D do	Fallow	Fallowed	------	------	(2)	0	34.4	47.8	23.8	29.4
Peanuts:										
293–W pounds	Milo	Spring plowed	------	------	------	------	------	[2] 510	680	820
339 do	Fallow	Fallowed	------	------	------	------	------	[2] 410	730	980
Sorgo:										
58 [1] bushels	Winter rye	Fall plowed	12.2	30.2	0	28.8	51.4	38.0	45.4	45.2
Total weight:										
Peanuts:										
293–W pounds	Milo	Spring plowed	------	------	------	------	------	[2] 2,020	2,900	3,000
339 do	Fallow	Fallowed	------	------	------	------	------	[2] 2,000	2,950	3,800
Sorgo:										
58 [1] do	Winter rye	Fall plowed	4,275	10,740	10,850	9,500	11,150	10,600	9,750	10,000
239 do	Milo	Spring plowed	------	------	------	------	------	------	5,600	4,800
Sudan grass:										
84 do	do	Spring plowed	3,850	4,850	4,500	3,700	5,700	5,200	5,150	5,200
87 do	do	Spring plowed and manured.	4,630	4,800	5,850	4,800	5,550	6,250	5,750	5,550
Soybeans:										
336 do	Milo	Spring plowed	------	------	------	------	------	(2)	1,650	2,000
338 do	Fallow	Fallowed	------	------	------	------	------	(2)	2,800	2,550
Mixed plots:										
342 Cowpeas do	Milo	Spring plowed	------	------	------	------	------	[2] 1,400	1,100	950
342 Sudan do	do	do	------	------	------	------	------	[2] 3,950	2,200	2,450
341 Cowpeas do	do	do	------	------	------	------	------	[2] 3,000	1,300	1,550
341 Kafir (grain), bushels.	do	do	------	------	------	------	------	[2] 25.2	15.8	17.3
340 Cowpeas, pounds.	do	do	------	------	------	------	------	[2] 2,300	1,900	1,100
340 Milo (grain), bushels.	do	do	------	------	------	------	----	[2] 33.1	22.6	27.4

Crop and rotation or plot	Preceding crop	Tillage method	Acre yield							
			1932	1933	1934	1935	1936	1937	1938	Average
Grain yield:										
Oats:										
B bushels	Oats	Fall plowed	0.3	0	0	0	0	0	0	8.5
58 [1] do	Sorgo	Disked	0	0	0	0	0	0	0	1.7
59 [3] do	Cowpeas	do	0	0	0	0	0	0	0	8.1
C–D do	Fallow	Fallowed	4.7	0	0	0	0	0	0	11.7
Peanuts:										
293–W pounds	Milo	Spring plowed	240	0	0	340	20	280	370	306
339 do	Fallow	Fallowed	590	0	10	620	160	230	290	401
Sorgo:										
58 [1] bushels	Winter rye	Fall plowed	17.0	0	0	0	5.4	19.5	6.5	13.8
Total weight:										
Peanuts:										
293–W pounds	Milo	Spring plowed	1,200	0	200	1,760	650	1,250	1,600	1,396
339 do	Fallow	Fallowed	2,450	0	750	2,380	1,700	1,350	1,550	1,881
Sorgo:										
58 [1] do	Winter rye	Fall plowed	5,250	0	200	3,610	2,650	7,350	5,450	5,459
239 do	Milo	Spring plowed	4,150	0	400	1,700	900	2,050	5,100	2,388
Sudan grass:										
84 do	do	do	2,900	0	0	1,290	500	2,150	2,400	2,897
87 do	do	Spring plowed and manured.	3,150	0	0	1,530	450	2,050	2,400	3,143
Soybeans:										
336 do	Milo	Spring plowed	700	0	0	750	350	950	300	744
338 do	Fallow	Fallowed	1,700	0	0	1,900	1,550	1,600	350	1,383
Mixed plots:										
342 Cowpeas do	Milo	Spring plowed	400	0	200	500	200	250	50	406
342 Sudan do	do	do	1,350	0	200	800	400	1,200	1,750	1,150
341 Cowpeas do	do	do	950	0	300	900	250	350	350	661
341 Kafir (grain), bushels.	do	do	11.5	0	0	2.2	.2	4.7	5.4	6.3
340 Cowpeas, pounds.	do	do	1,300	0	800	800	150	250	400	744
340 Milo (grain), bushels.	do	do	12.8	0	.9	1.9	0	3.8	12.5	9.1

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[1] Rotation 58, south field 1908–14, north field 1915–24, west field 1925 to present.

[2] Not included in average.

[3] Rotation 59, north field 1914–24, west field 1925 to present.

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